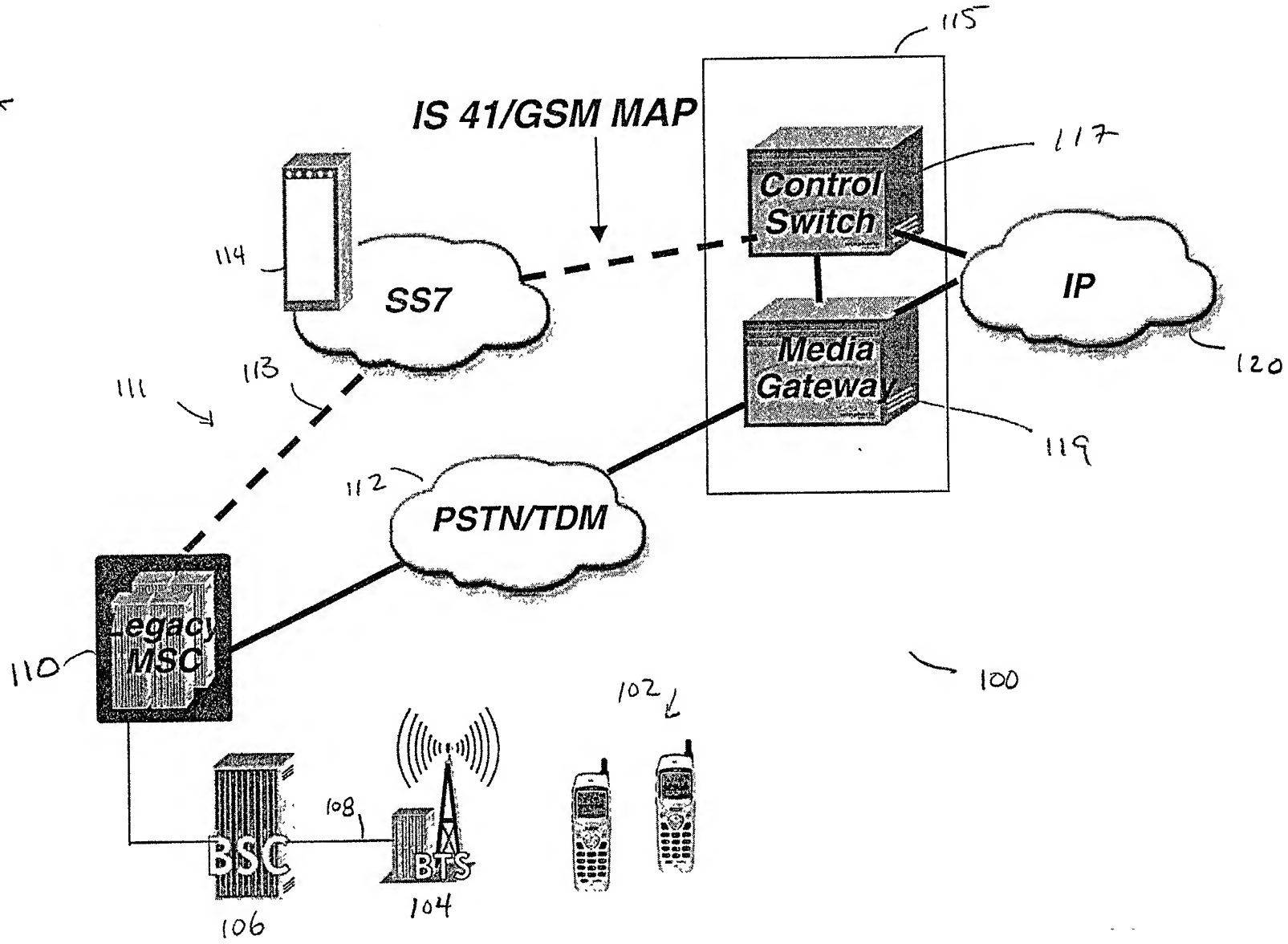
Fig. 1
Prior Art



20211.0 6112500

Fig. 2
Prior Art

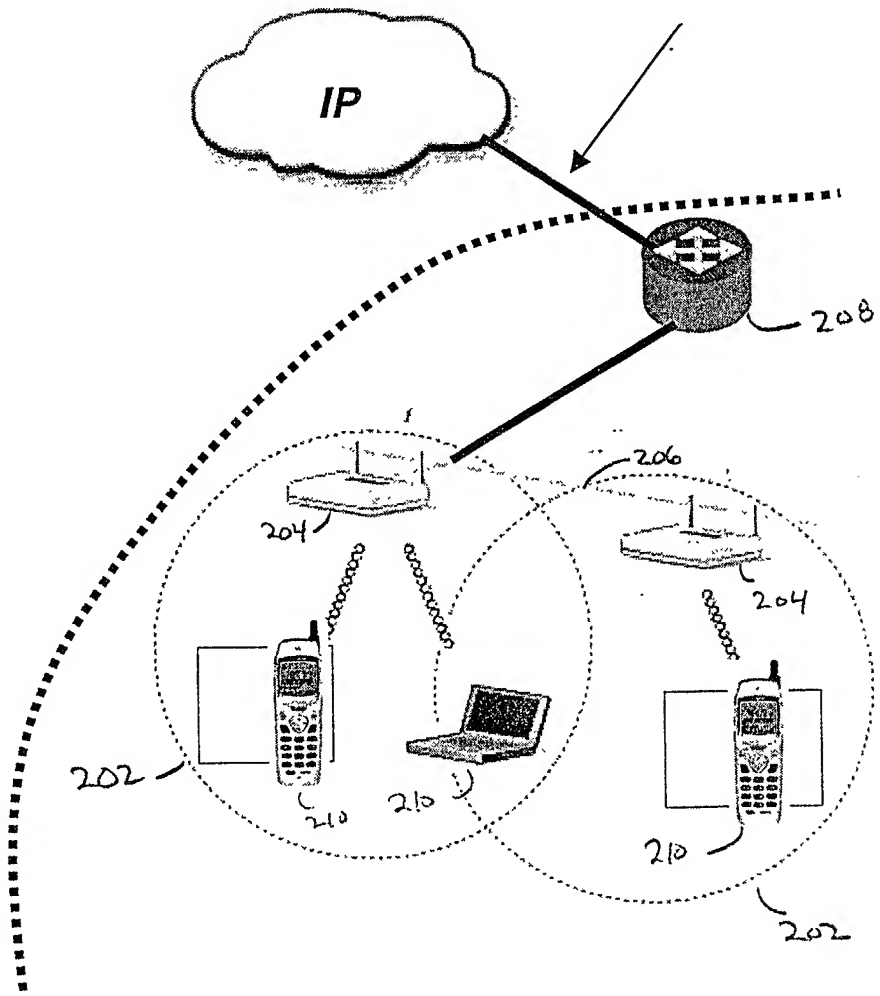


Fig. 3

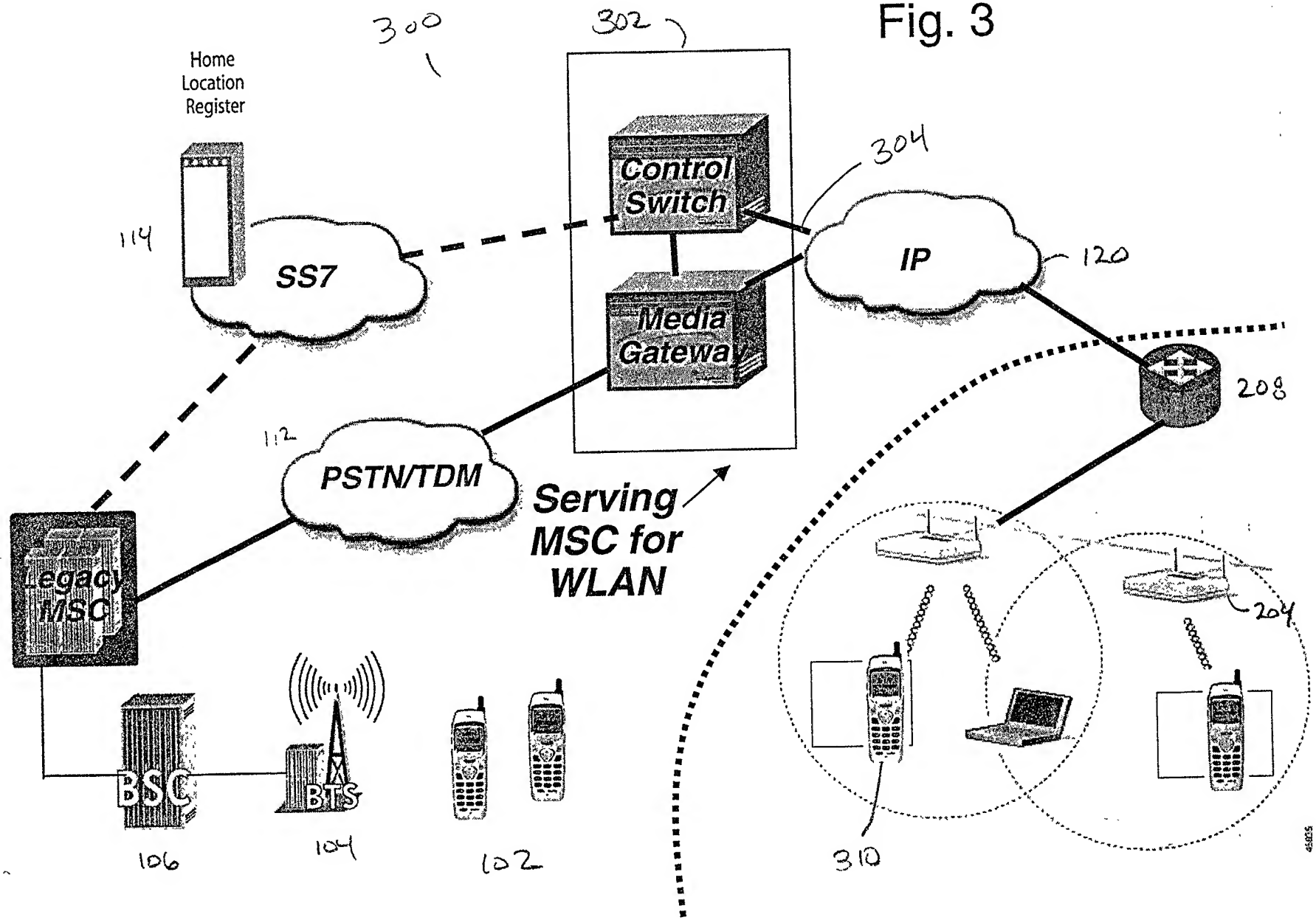

300
302
Home Location Register
114
SS7
Control Switch
304
IP
120
Media Gateway
208
112
PSTN/TDM
Serving MSC for WLAN
Legacy MSC
110
BSC
BTS
106
104
102
204
310

Fig. 4

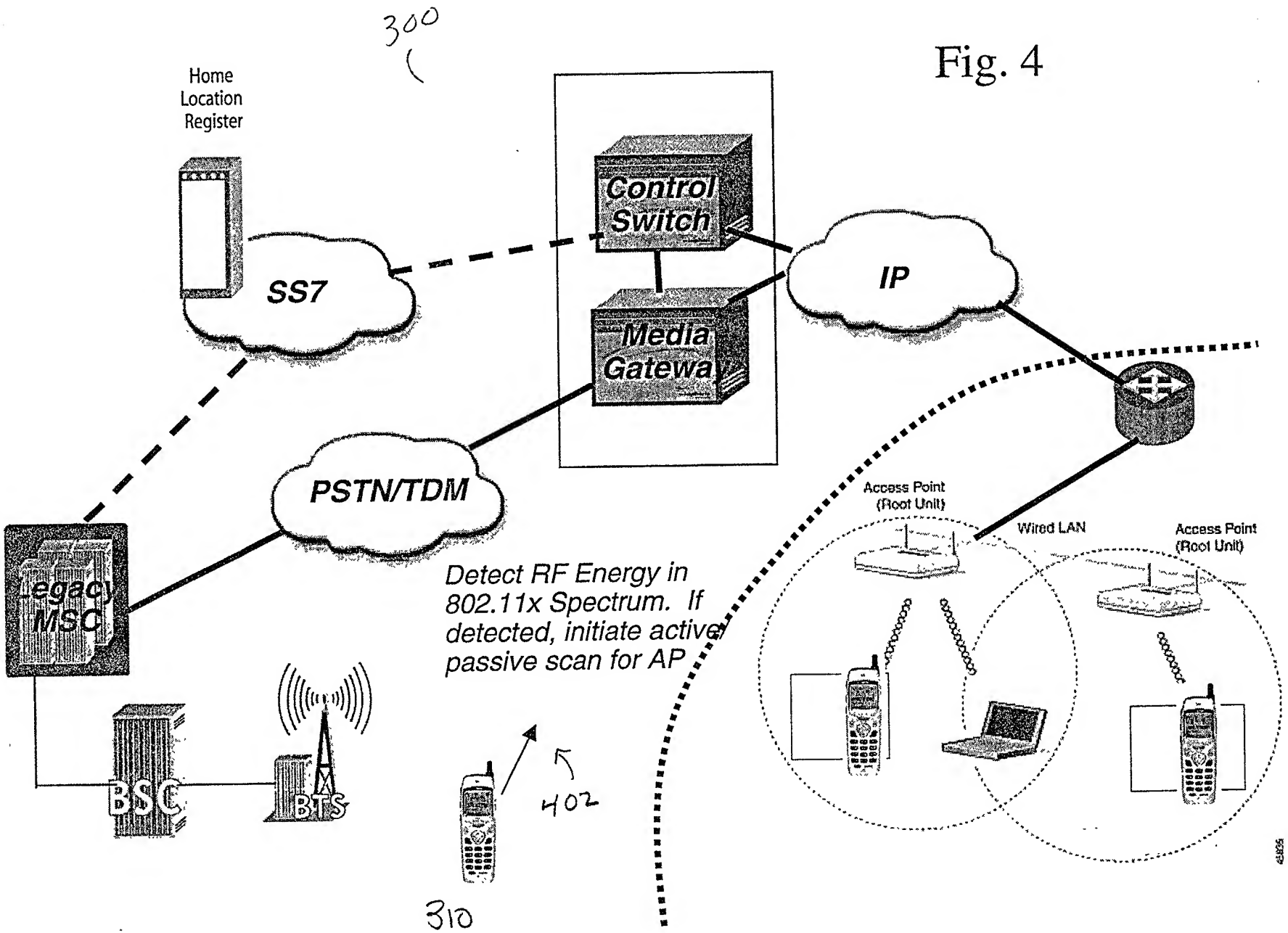

300
Home Location Register
SS7
Control Switch
IP
Media Gateway
PSTN/TDM
Legacy MSC
BSC
BTS
Detect RF Energy in 802.11x Spectrum. If detected, initiate active/passive scan for AP
402
310
Access Point (Root Unit)
Wired LAN
Access Point (Root Unit)

Fig. 5

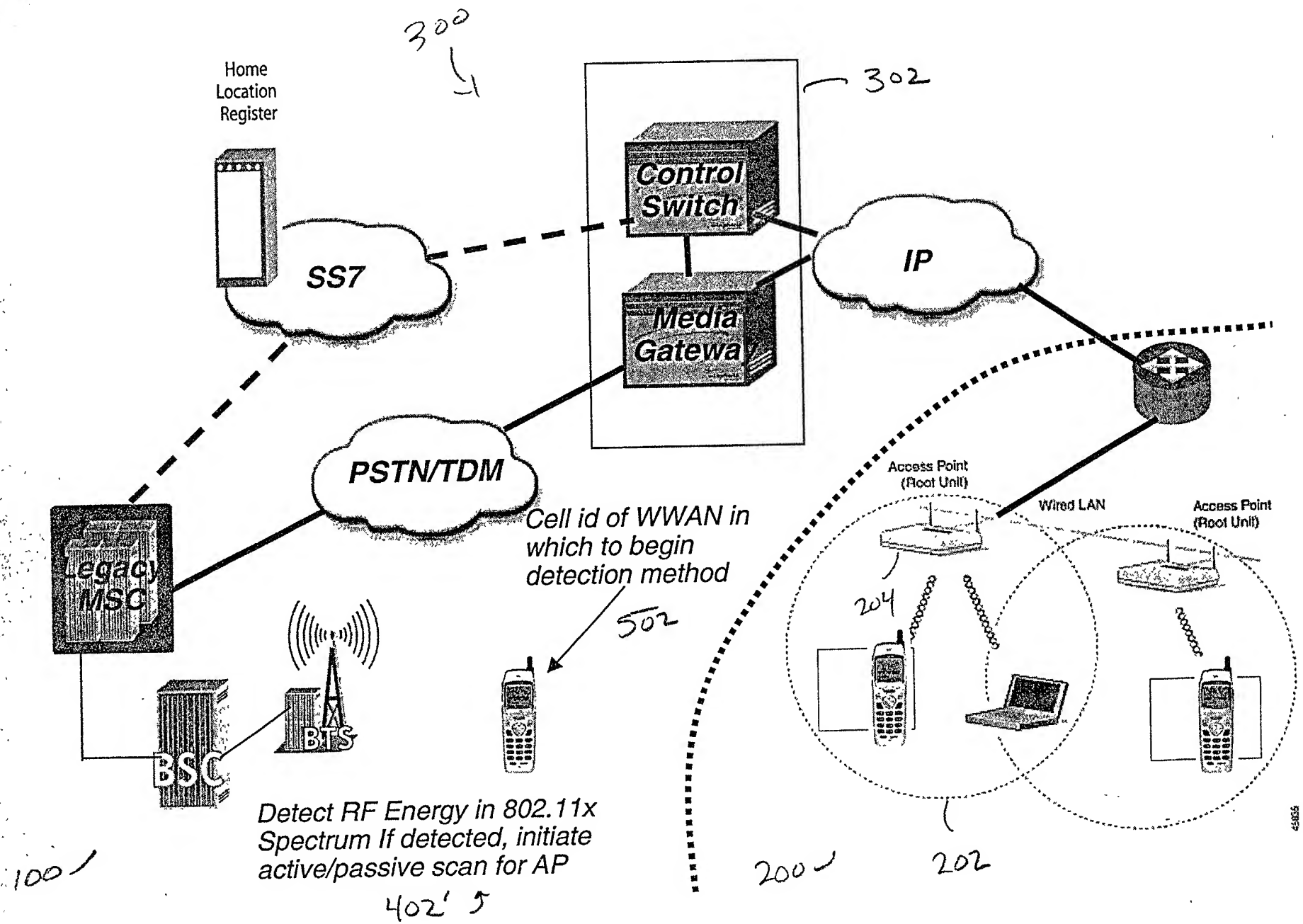

300
Home Location Register
302
Control Switch
SS7
IP
Media Gatewa
PSTN/TDM
Legacy MSC
Cell id of WWAN in which to begin detection method
502
BSC
BTS
Access Point (Root Unit)
Wired LAN
Access Point (Root Unit)
204
Detect RF Energy in 802.11x Spectrum If detected, initiate active/passive scan for AP
402'
100
200
202

Fig. 6

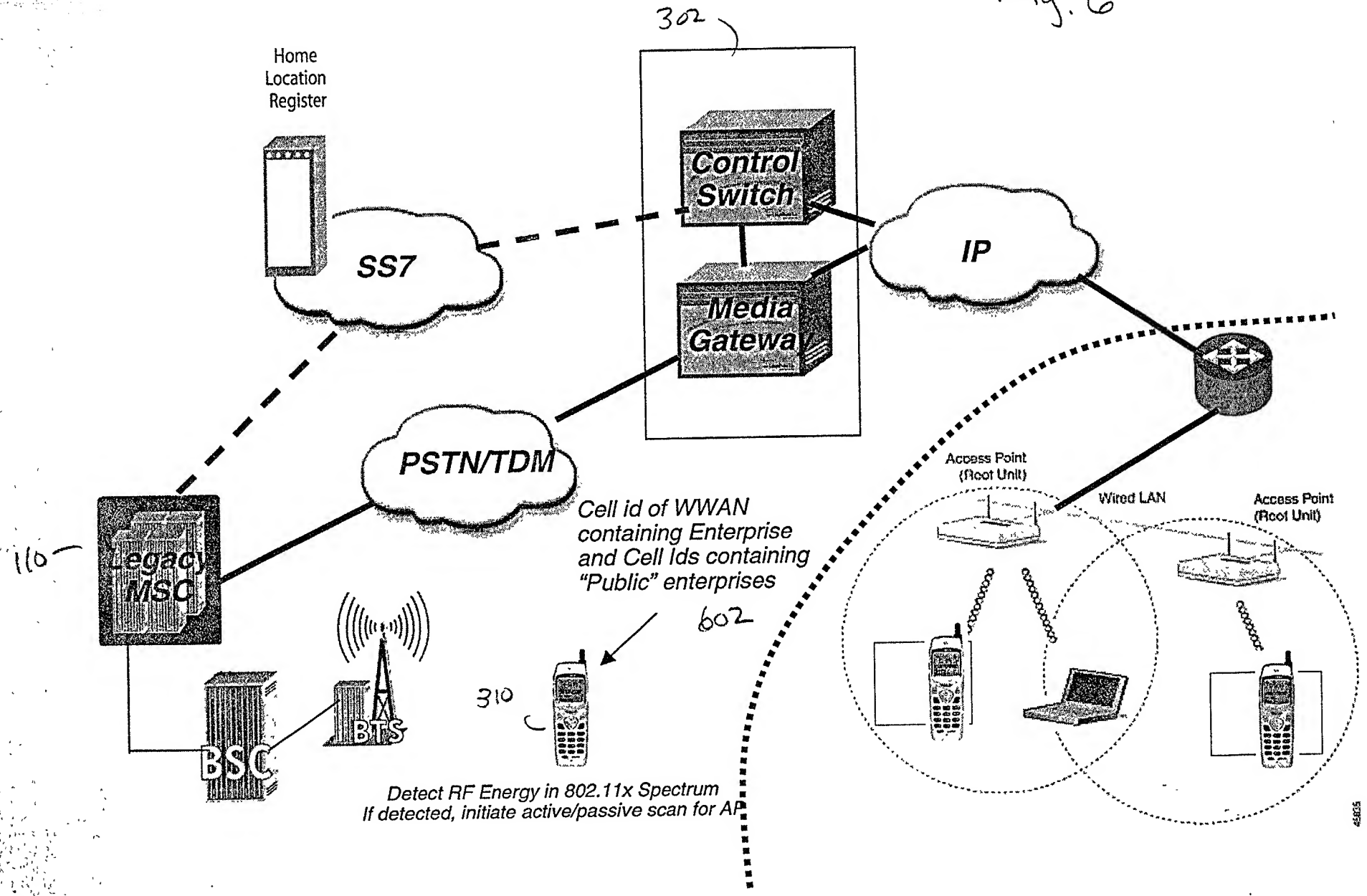

302
Home Location Register
SS7
Control Switch
IP
Media Gateway
PSTN/TDM
110
Legacy MSC
BSC
BTS
Cell id of WWAN containing Enterprise and Cell Ids containing "Public" enterprises
602
310
Detect RF Energy in 802.11x Spectrum
If detected, initiate active/passive scan for AP
Access Point (Root Unit)
Wired LAN
Access Point (Root Unit)

Figure 7

CDMA

Multi-mode Phone

IS95/CDMA2000
+
WLAN modem
+
VoIP (SIP/RTP/UDP/IP)
+
Mobility via Preferred Embodiment Client

310

GSM/UMTS

Multi-mode Phone

GSM/UMTS
+
WLAN modem
+
VoIP (SIP/RTP/UDP/IP)
+
Mobility via Preferred Embodiment Client

Fig. 8

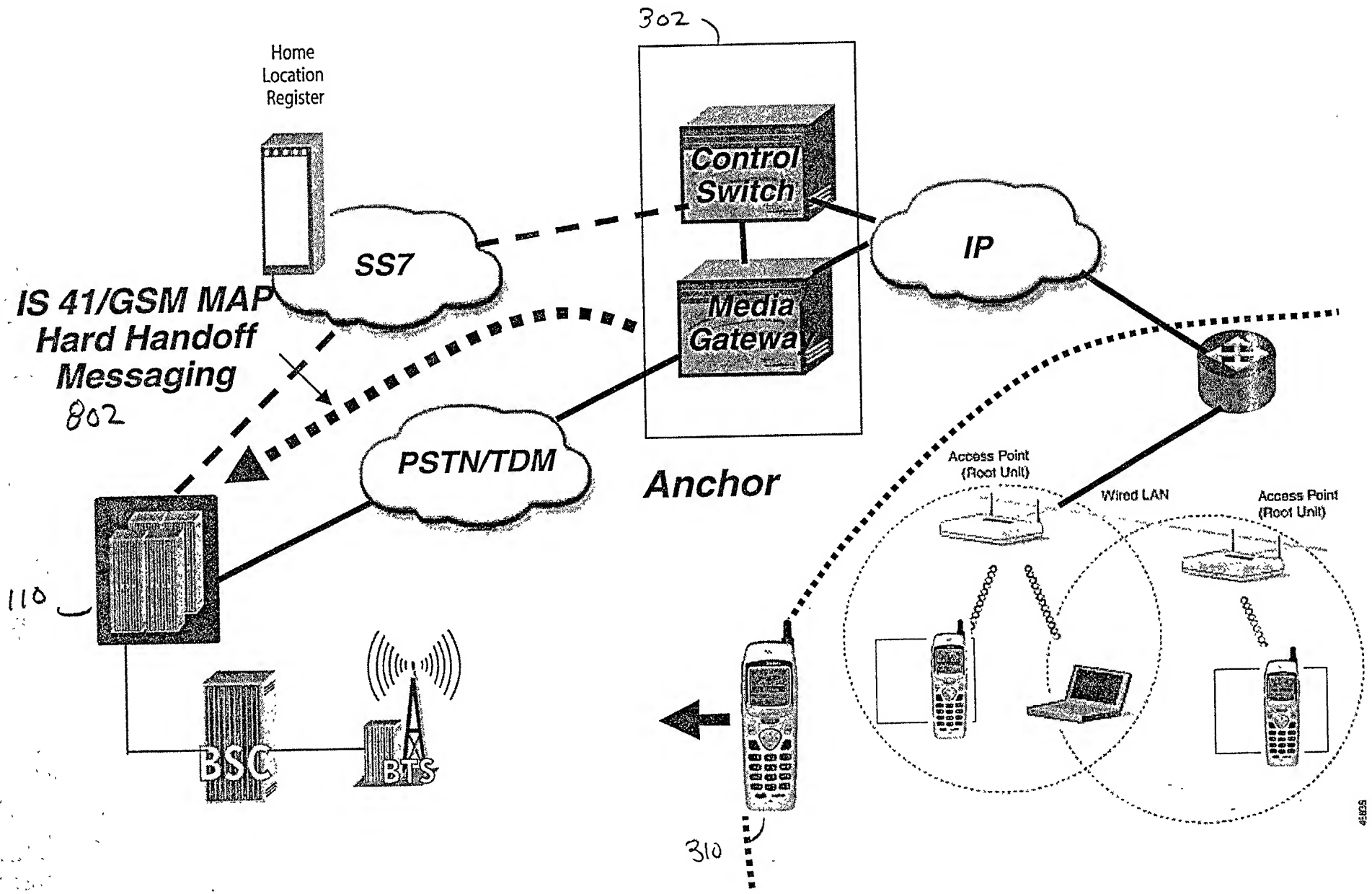

302
Home Location Register
Control Switch
SS7
IP
IS 41/GSM MAP Hard Handoff Messaging
802
Media Gateway
PSTN/TDM
Anchor
110
BSC
BTS
Access Point (Root Unit)
Wired LAN
Access Point (Root Unit)
310

Fig. 9

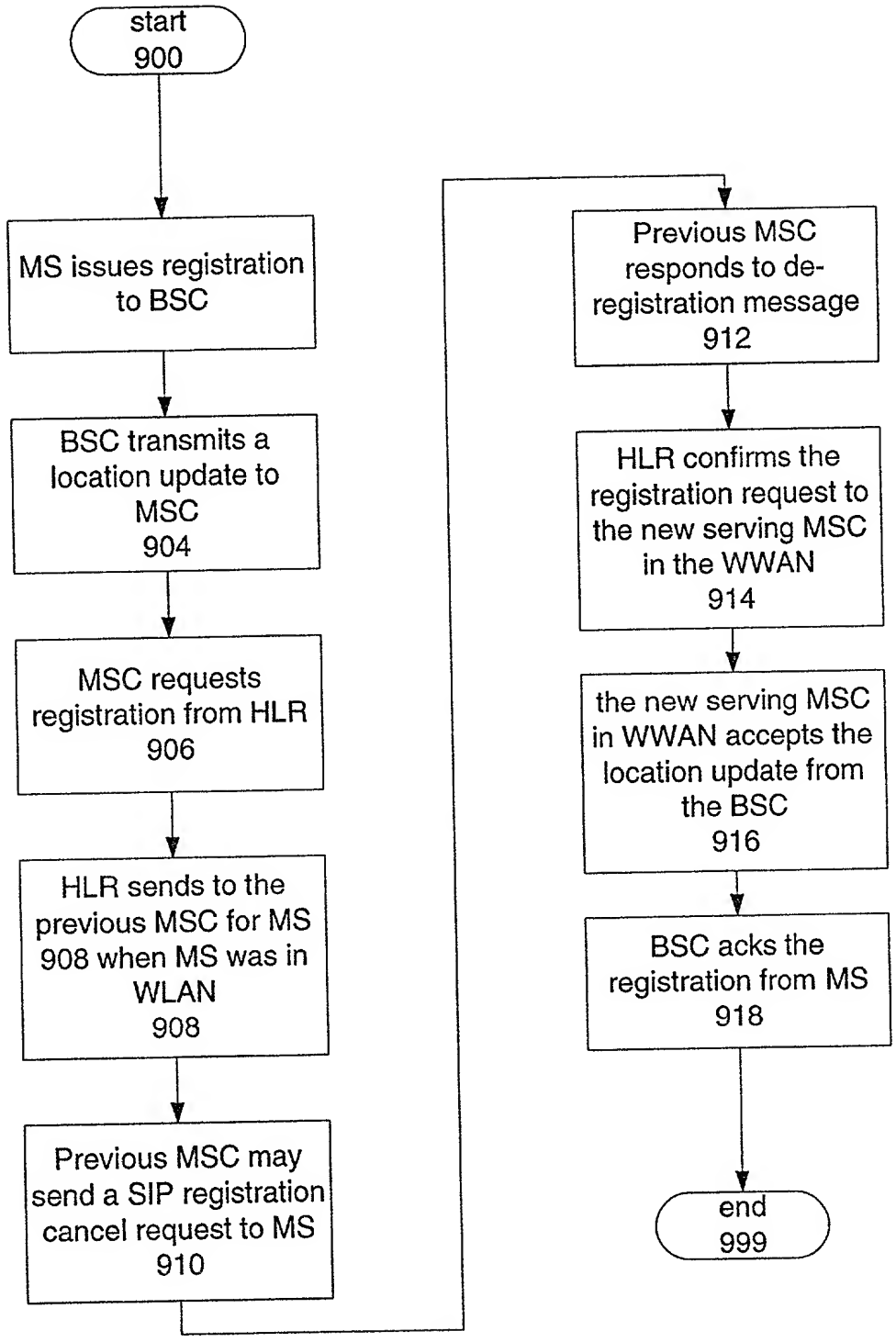

start
900
MS issues registration to BSC
BSC transmits a location update to MSC
904
MSC requests registration from HLR
906
HLR sends to the previous MSC for MS 908 when MS was in WLAN
908
Previous MSC may send a SIP registration cancel request to MS
910
Previous MSC responds to de-registration message
912
HLR confirms the registration request to the new serving MSC in the WWAN
914
the new serving MSC in WWAN accepts the location update from the BSC
916
BSC acks the registration from MS
918
end
999

Figure 10

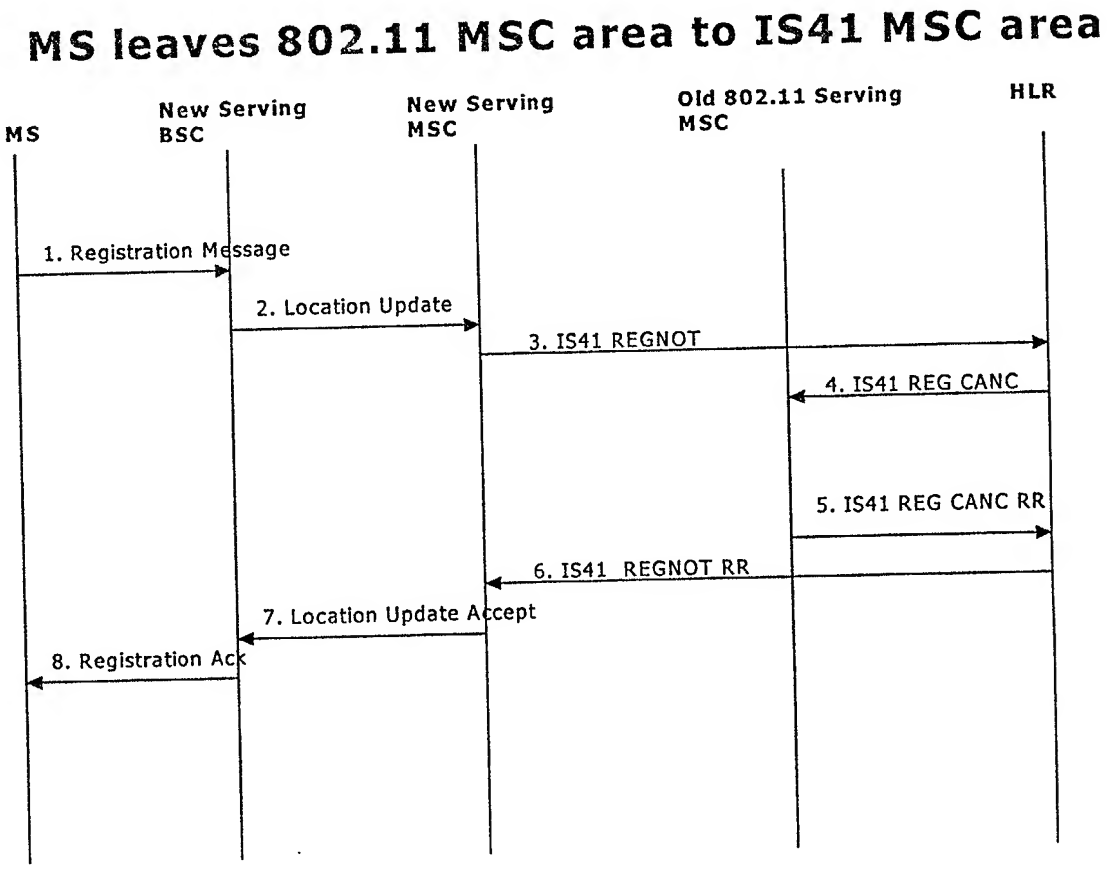

MS leaves 802.11 MSC area to IS41 MSC area
MS
New Serving BSC
New Serving MSC
Old 802.11 Serving MSC
HLR
1. Registration Message
2. Location Update
3. IS41 REGNOT
4. IS41 REG CANC
5. IS41 REG CANC RR
6. IS41 REGNOT RR
7. Location Update Accept
8. Registration Ack

Figure 11

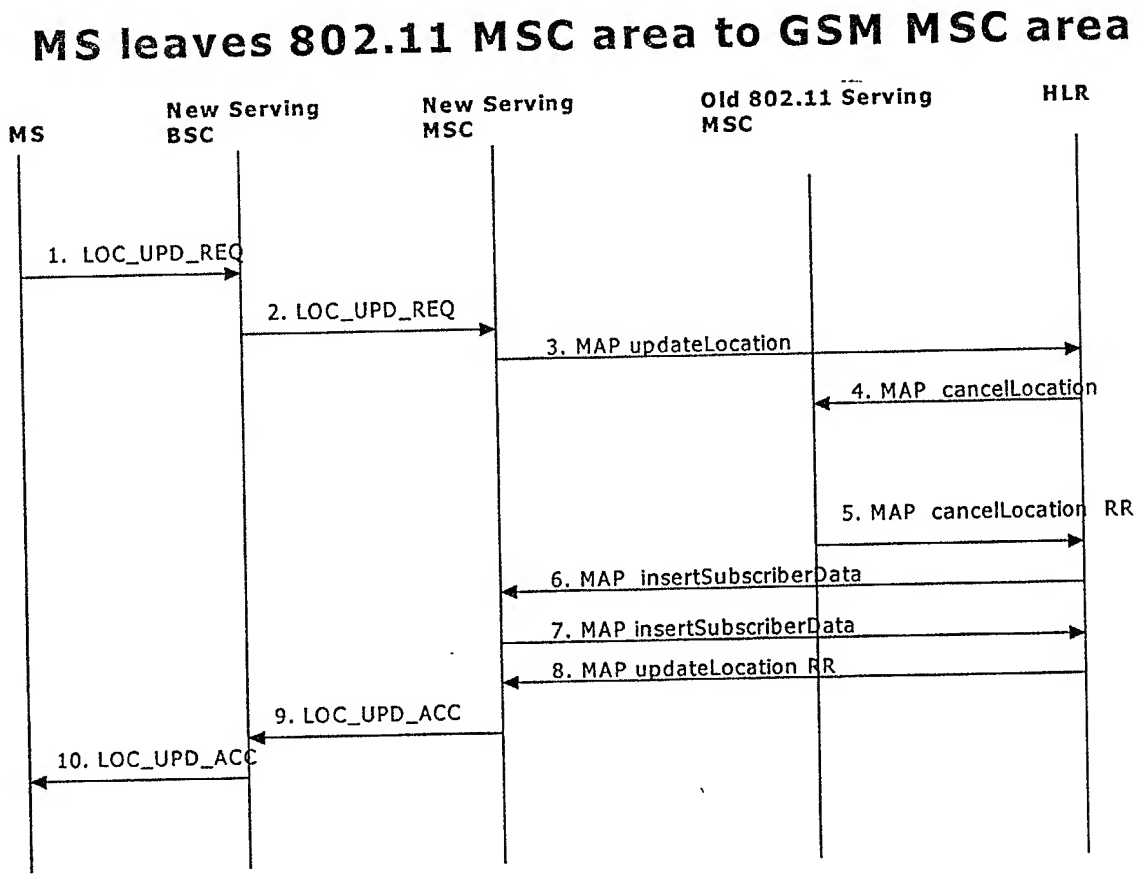

MS leaves 802.11 MSC area to GSM MSC area
MS
New Serving BSC
New Serving MSC
Old 802.11 Serving MSC
HLR
1. LOC_UPD_REQ
2. LOC_UPD_REQ
3. MAP updateLocation
4. MAP cancelLocation
5. MAP cancelLocation RR
6. MAP insertSubscriberData
7. MAP insertSubscriberData
8. MAP updateLocation RR
9. LOC_UPD_ACC
10. LOC_UPD_ACC

Fig. 12

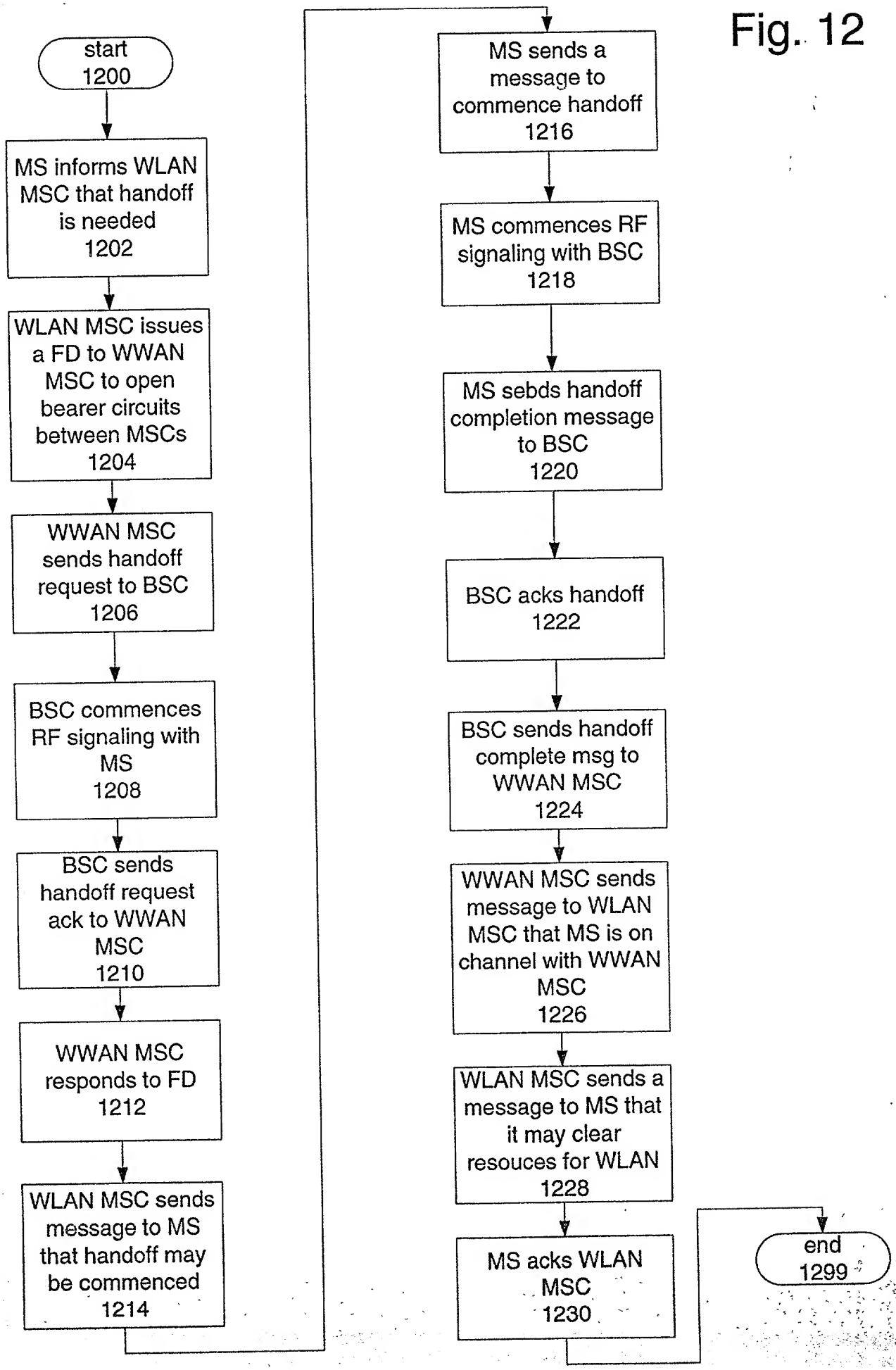

start
1200
MS informs WLAN MSC that handoff is needed
1202
WLAN MSC issues a FD to WWAN MSC to open bearer circuits between MSCs
1204
WWAN MSC sends handoff request to BSC
1206
BSC commences RF signaling with MS
1208
BSC sends handoff request ack to WWAN MSC
1210
WWAN MSC responds to FD
1212
WLAN MSC sends message to MS that handoff may be commenced
1214
MS sends a message to commence handoff
1216
MS commences RF signaling with BSC
1218
MS sebds handoff completion message to BSC
1220
BSC acks handoff
1222
BSC sends handoff complete msg to WWAN MSC
1224
WWAN MSC sends message to WLAN MSC that MS is on channel with WWAN MSC
1226
WLAN MSC sends a message to MS that it may clear resouces for WLAN
1228
MS acks WLAN MSC
1230
end
1299

Figure 13

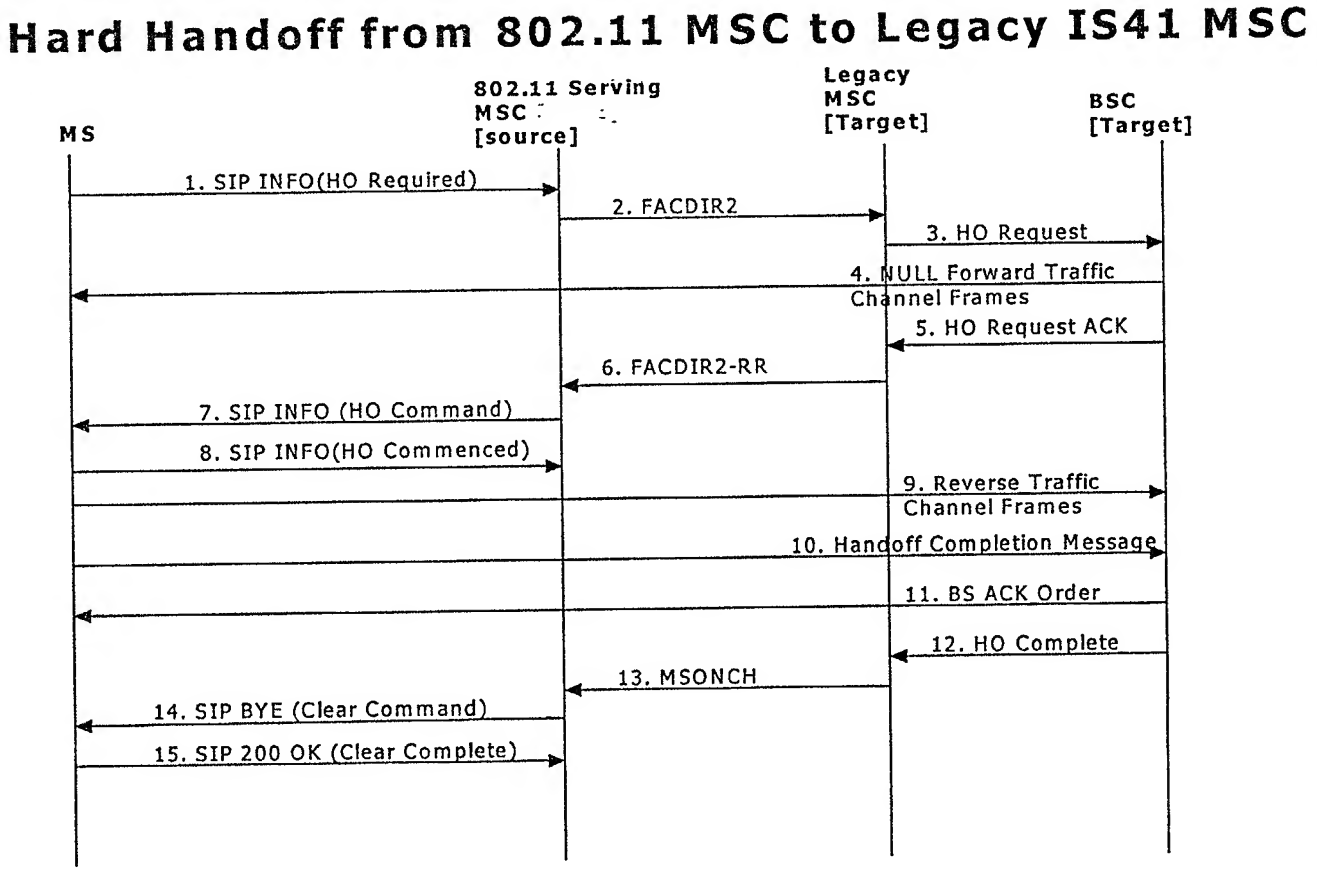

Hard Handoff from 802.11 MSC to Legacy IS41 MSC
MS
802.11 Serving MSC [source]
Legacy MSC [Target]
BSC [Target]
1. SIP INFO(HO Required)
2. FACDIR2
3. HO Request
4. NULL Forward Traffic Channel Frames
5. HO Request ACK
6. FACDIR2-RR
7. SIP INFO (HO Command)
8. SIP INFO(HO Commenced)
9. Reverse Traffic Channel Frames
10. Handoff Completion Message
11. BS ACK Order
12. HO Complete
13. MSONCH
14. SIP BYE (Clear Command)
15. SIP 200 OK (Clear Complete)

Figure 14

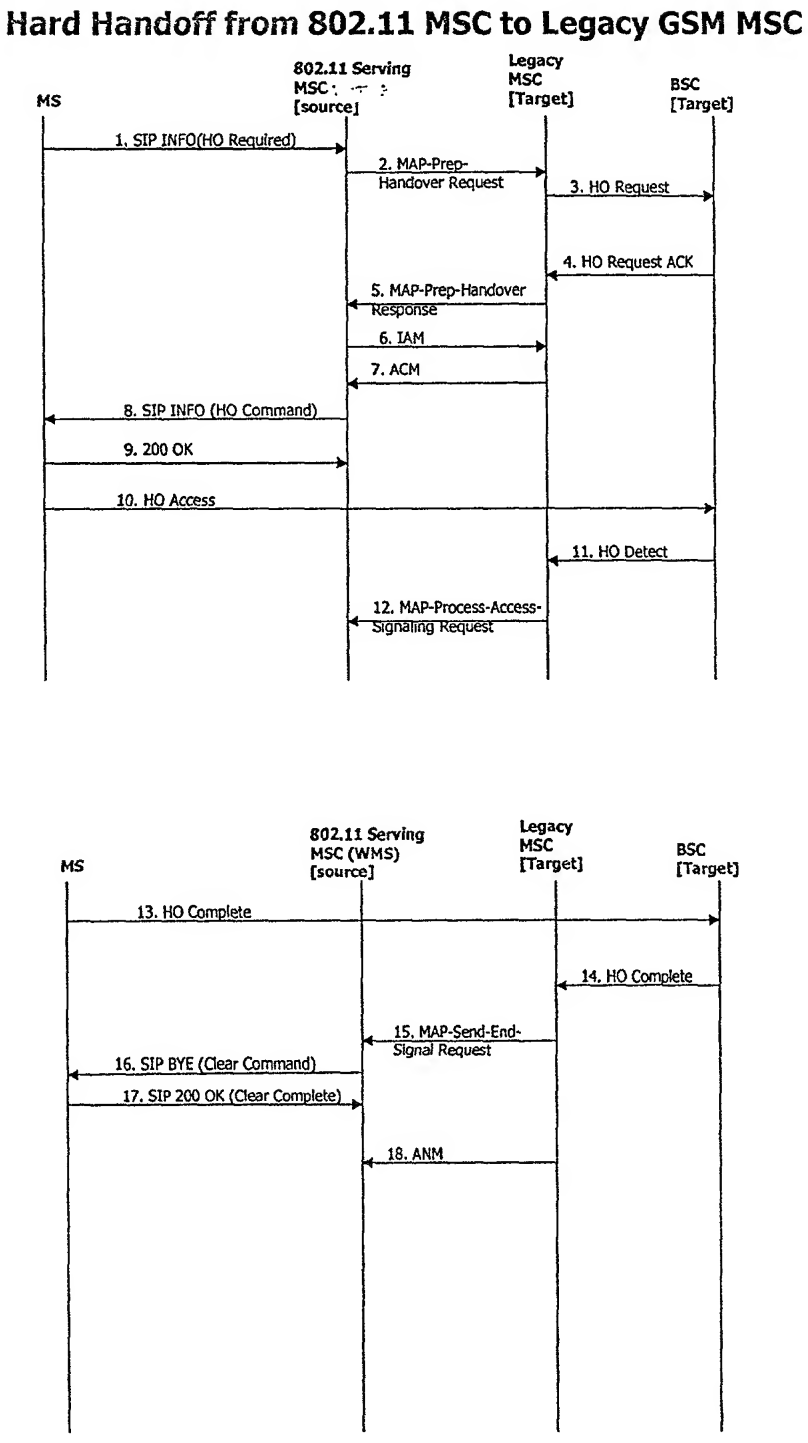


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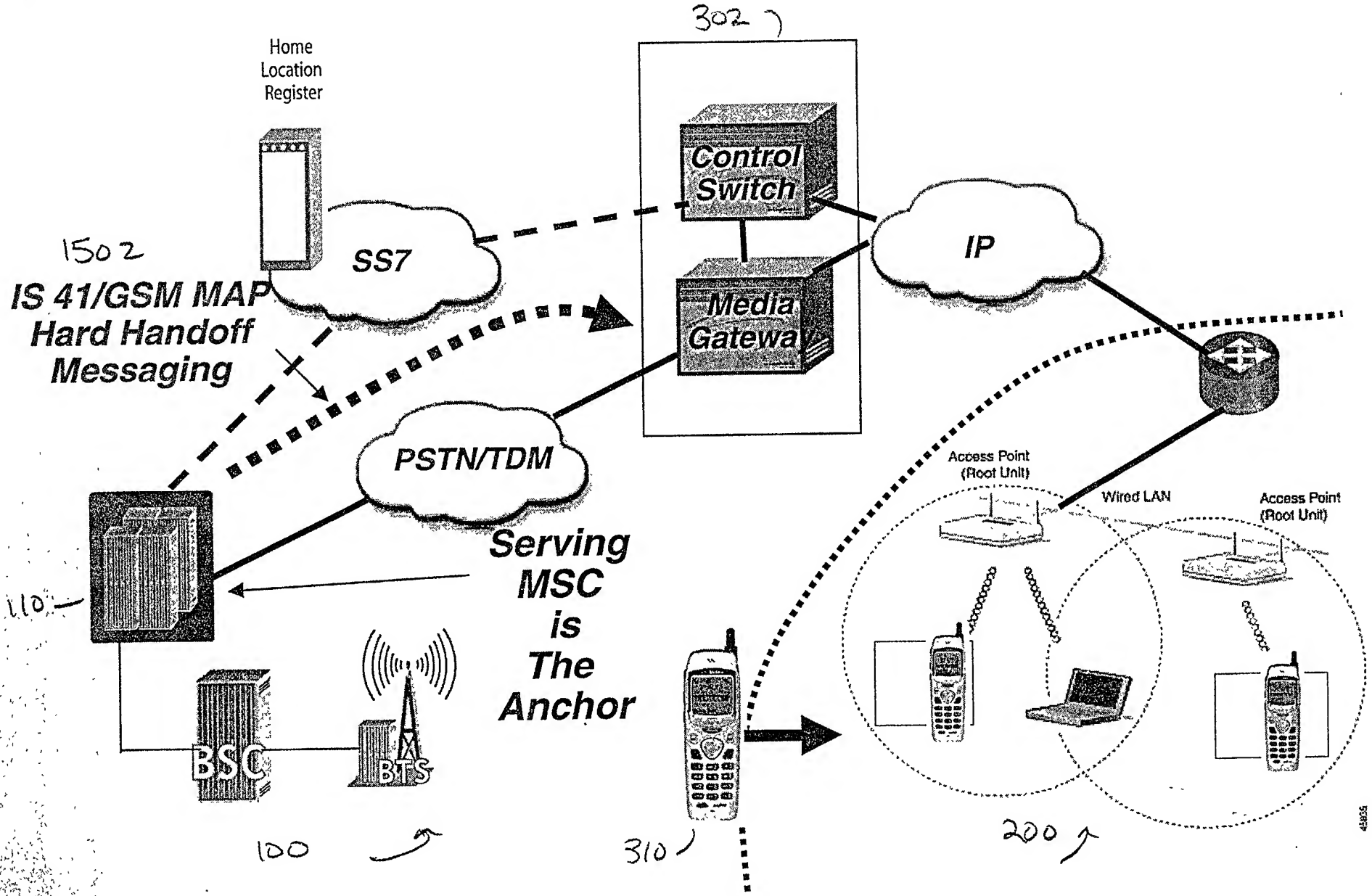
Fig. 15


302
Home Location Register
Control Switch
SS7
IP
1502
IS 41/GSM MAP Hard Handoff Messaging
Media Gateway
PSTN/TDM
Serving MSC is The Anchor
110
BSC
BTS
100
310
Access Point (Root Unit)
Wired LAN
Access Point (Root Unit)
200

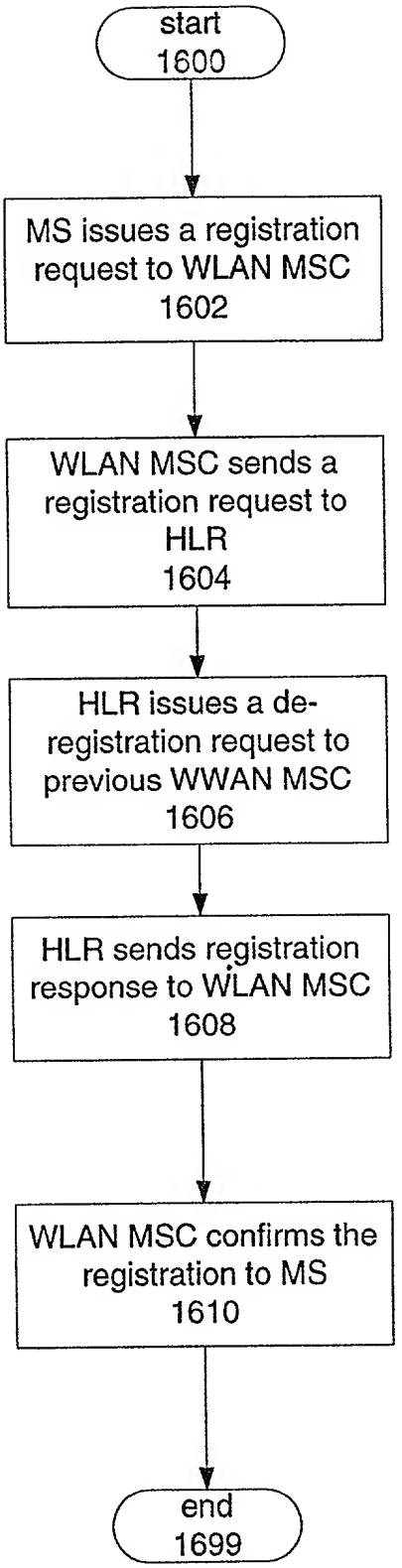

start
1600
MS issues a registration request to WLAN MSC
1602
WLAN MSC sends a registration request to HLR
1604
HLR issues a de-registration request to previous WWAN MSC
1606
HLR sends registration response to WLAN MSC
1608
WLAN MSC confirms the registration to MS
1610
end
1699

Fig. 16

Figure 17

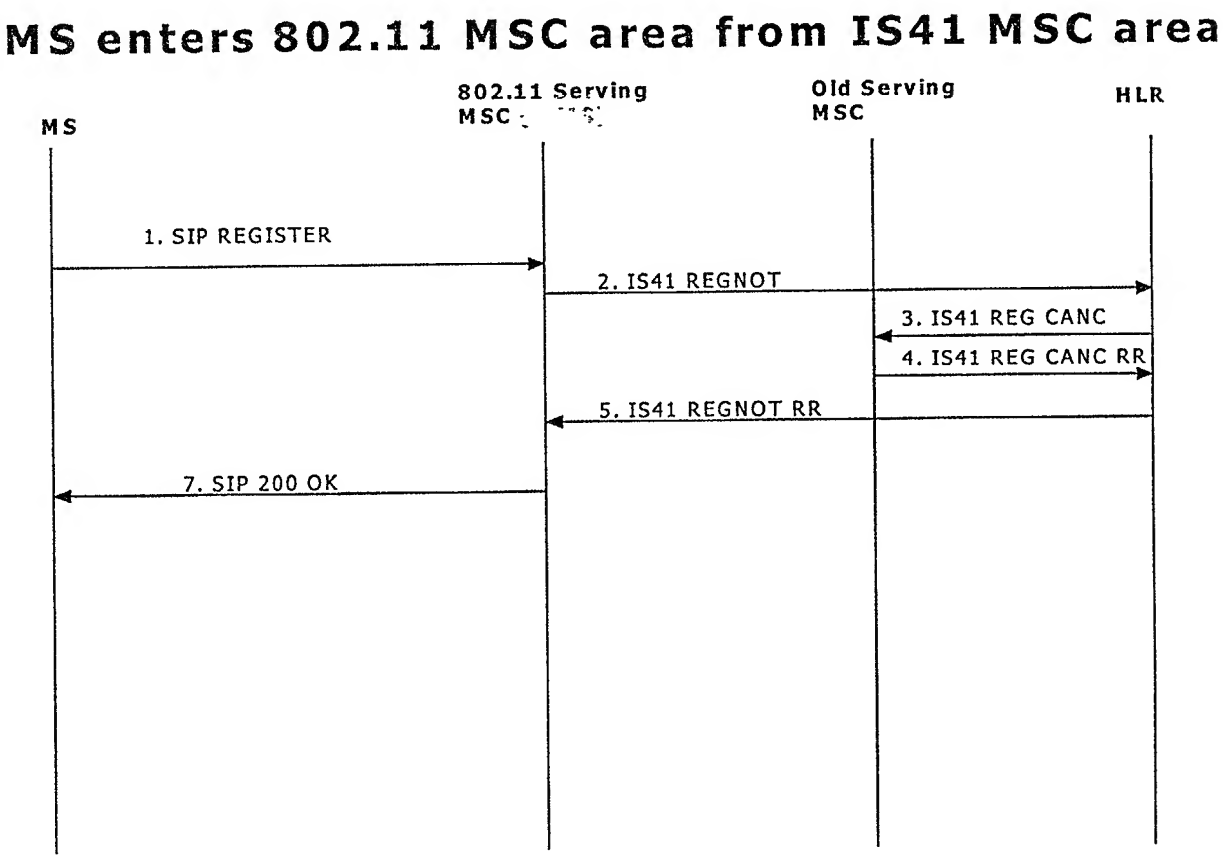
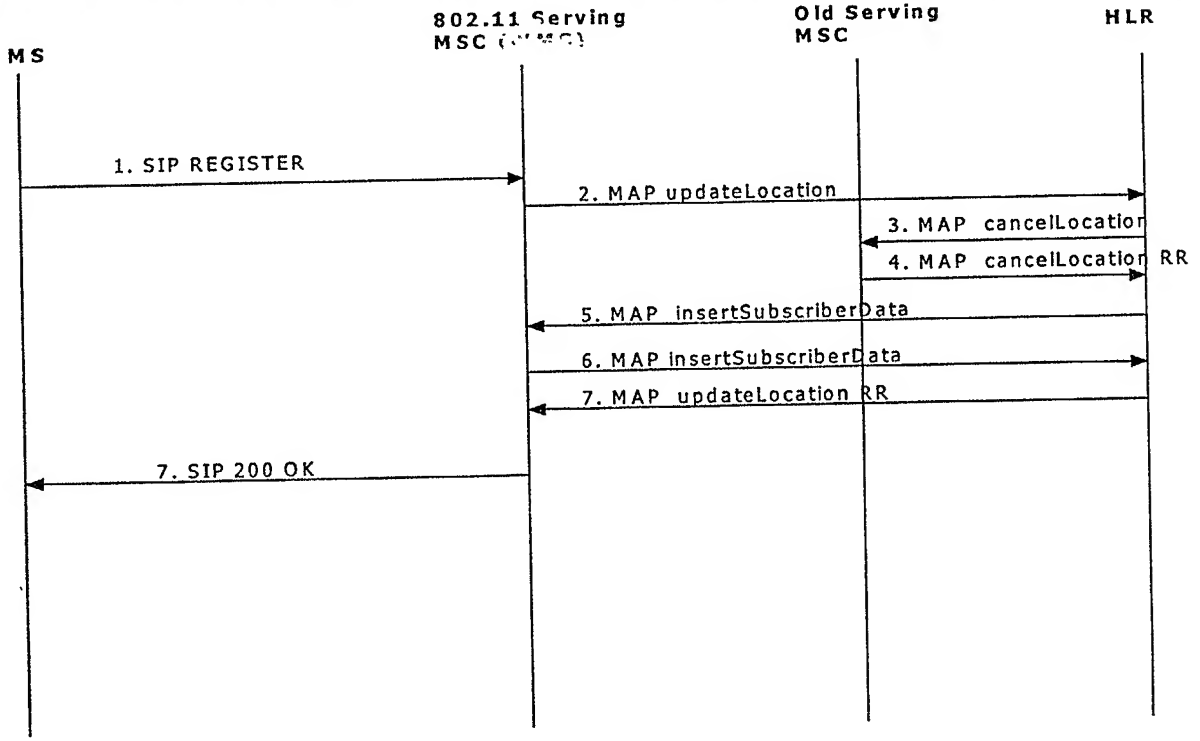

MS enters 802.11 MSC area from IS41 MSC area
MS
802.11 Serving MSC
Old Serving MSC
HLR
1. SIP REGISTER
2. IS41 REGNOT
3. IS41 REG CANC
4. IS41 REG CANC RR
5. IS41 REGNOT RR
7. SIP 200 OK

Figure 18

MS enters 802.11 MSC area from GSM MSC area



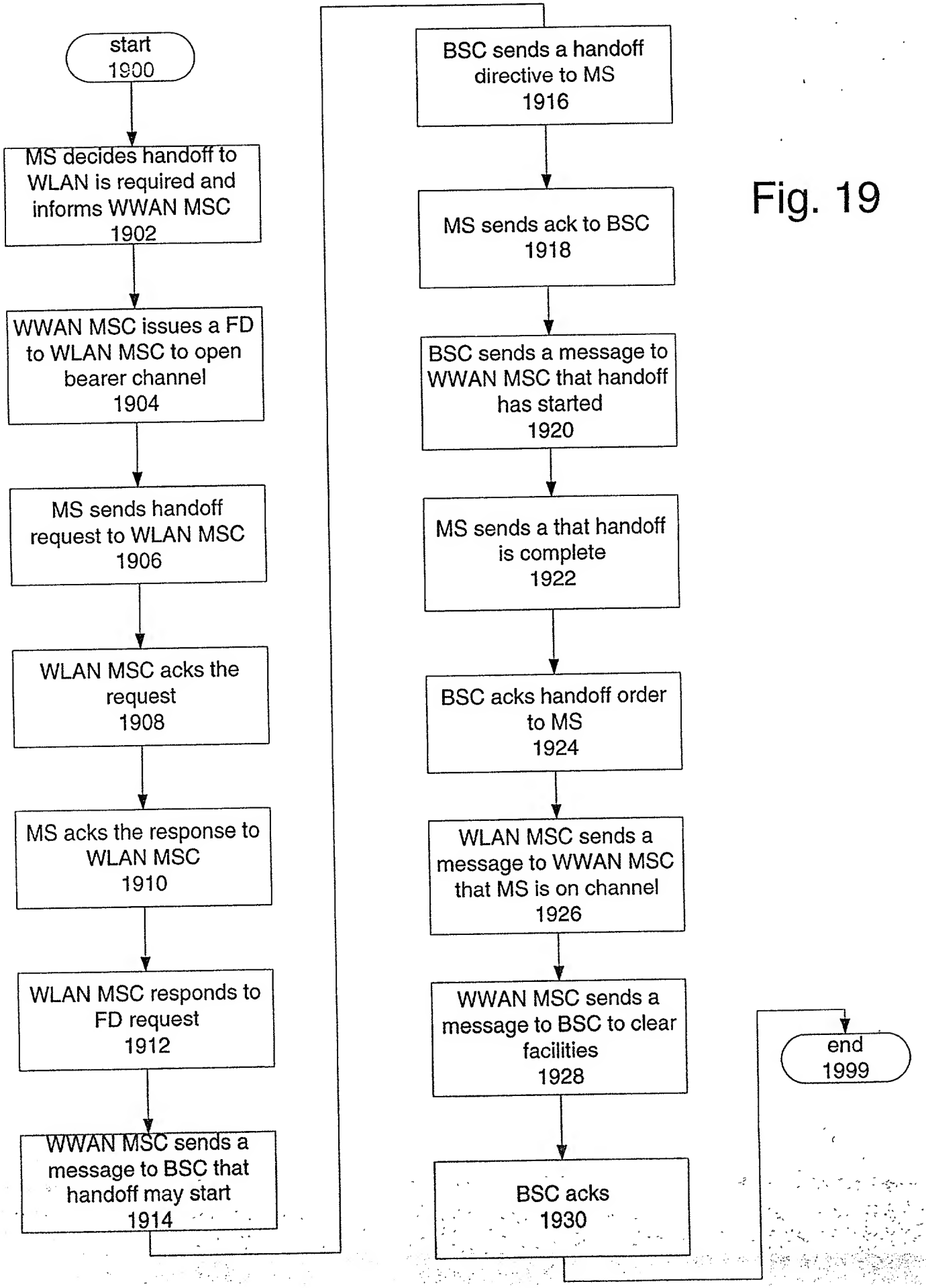

start
1900
MS decides handoff to WLAN is required and informs WWAN MSC
1902
WWAN MSC issues a FD to WLAN MSC to open bearer channel
1904
MS sends handoff request to WLAN MSC
1906
WLAN MSC acks the request
1908
MS acks the response to WLAN MSC
1910
WLAN MSC responds to FD request
1912
WWAN MSC sends a message to BSC that handoff may start
1914
BSC sends a handoff directive to MS
1916
MS sends ack to BSC
1918
BSC sends a message to WWAN MSC that handoff has started
1920
MS sends a that handoff is complete
1922
BSC acks handoff order to MS
1924
WLAN MSC sends a message to WWAN MSC that MS is on channel
1926
WWAN MSC sends a message to BSC to clear facilities
1928
BSC acks
1930
end
1999

Fig. 19

Figure 20

Hard Handoff from Legacy IS41 MSC to 802.11 MSC

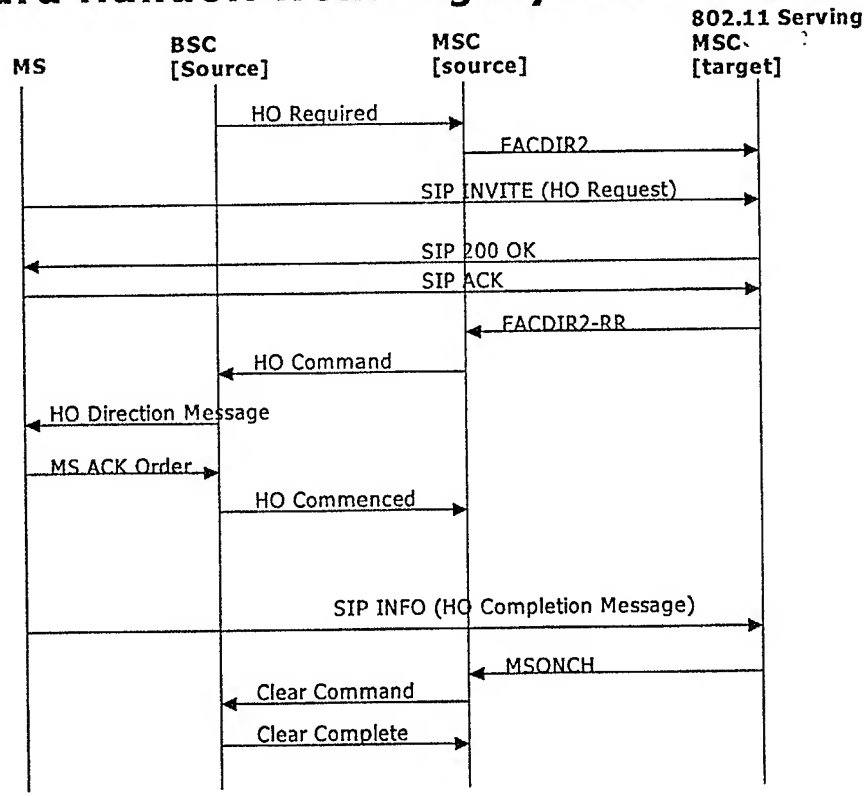


Figure 21

Hard Handoff from Legacy GSM MSC to 802.11 MSC

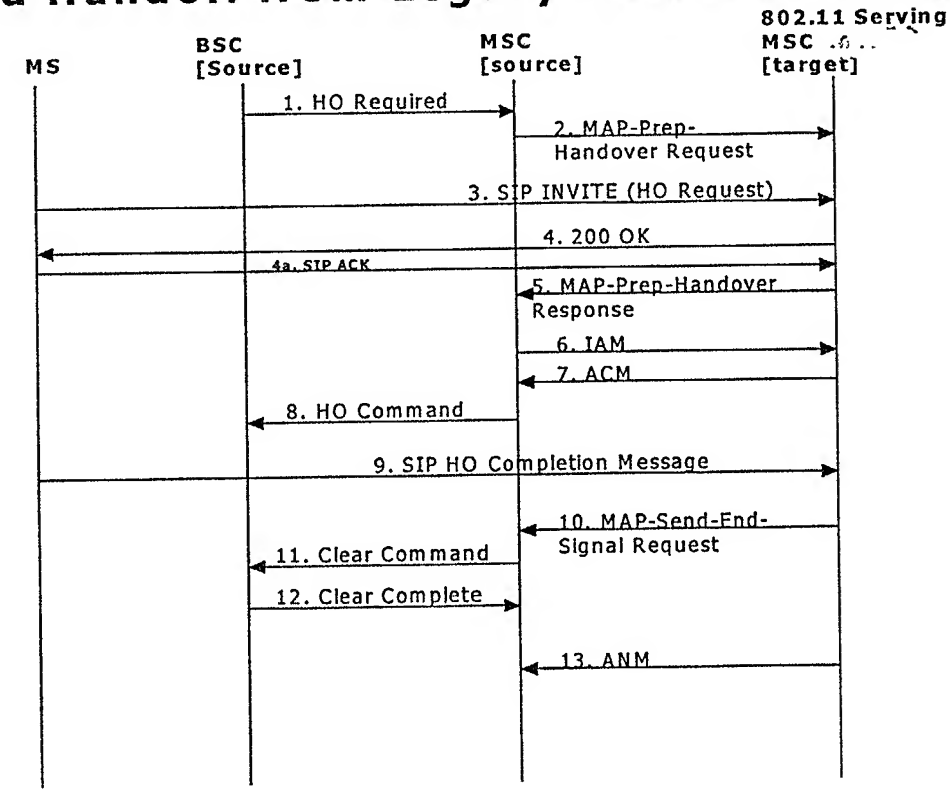


Figure 22

Delivery of Short Message Service in 802.11 MSC area

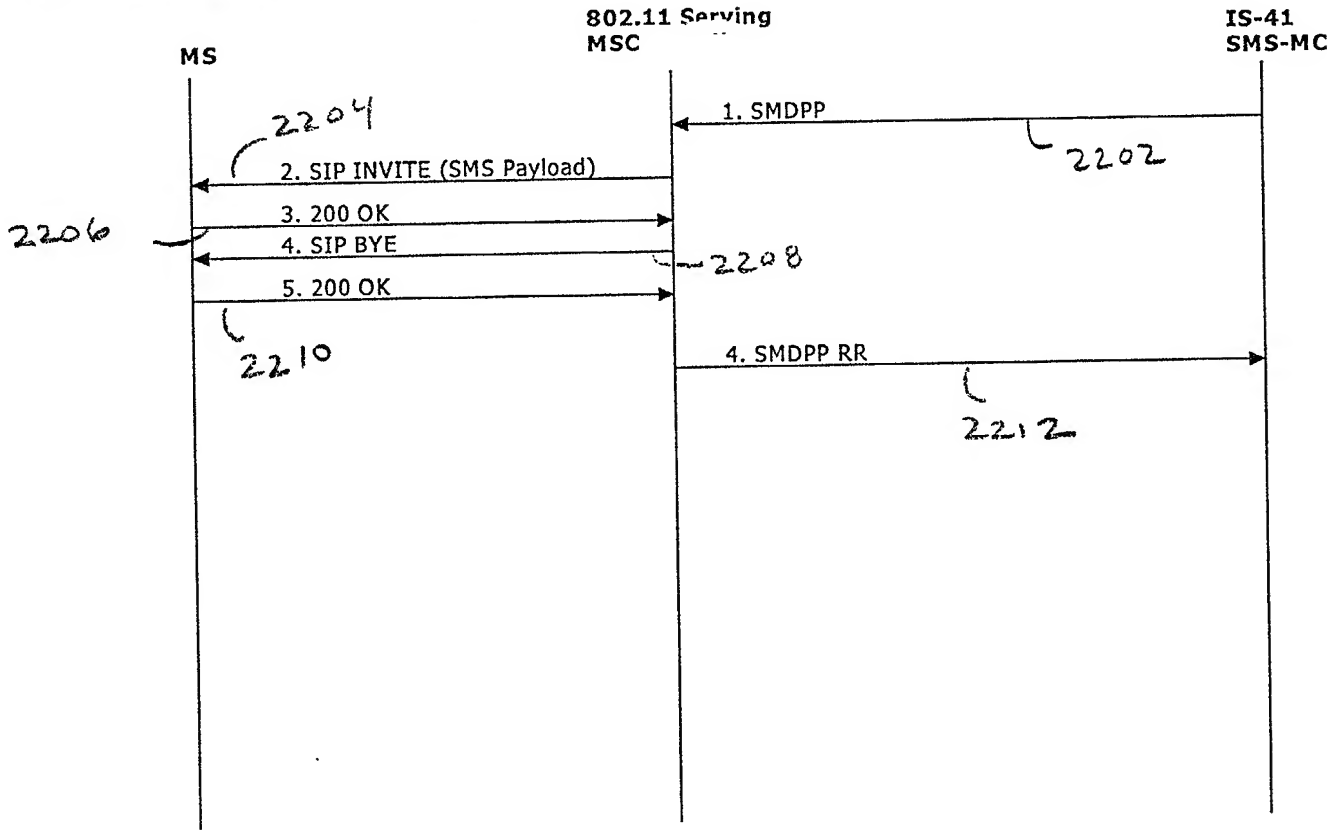


Figure 23

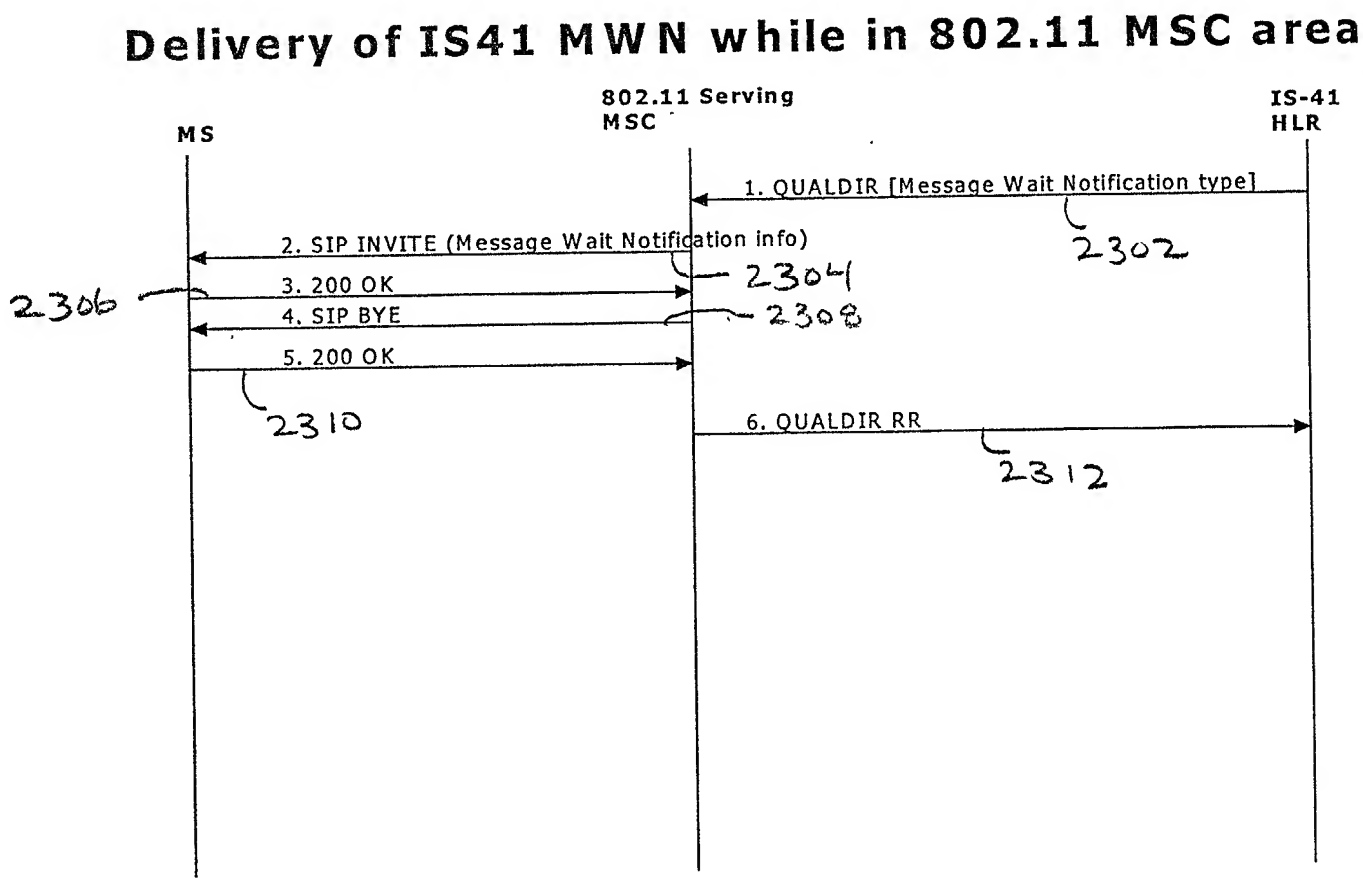

Delivery of IS41 MWN while in 802.11 MSC area
MS
802.11 Serving MSC
IS-41 HLR
1. QUALDIR [Message Wait Notification type]
2302
2. SIP INVITE (Message Wait Notification info)
2304
2306
3. 200 OK
4. SIP BYE
2308
5. 200 OK
2310
6. QUALDIR RR
2312

Figure 24

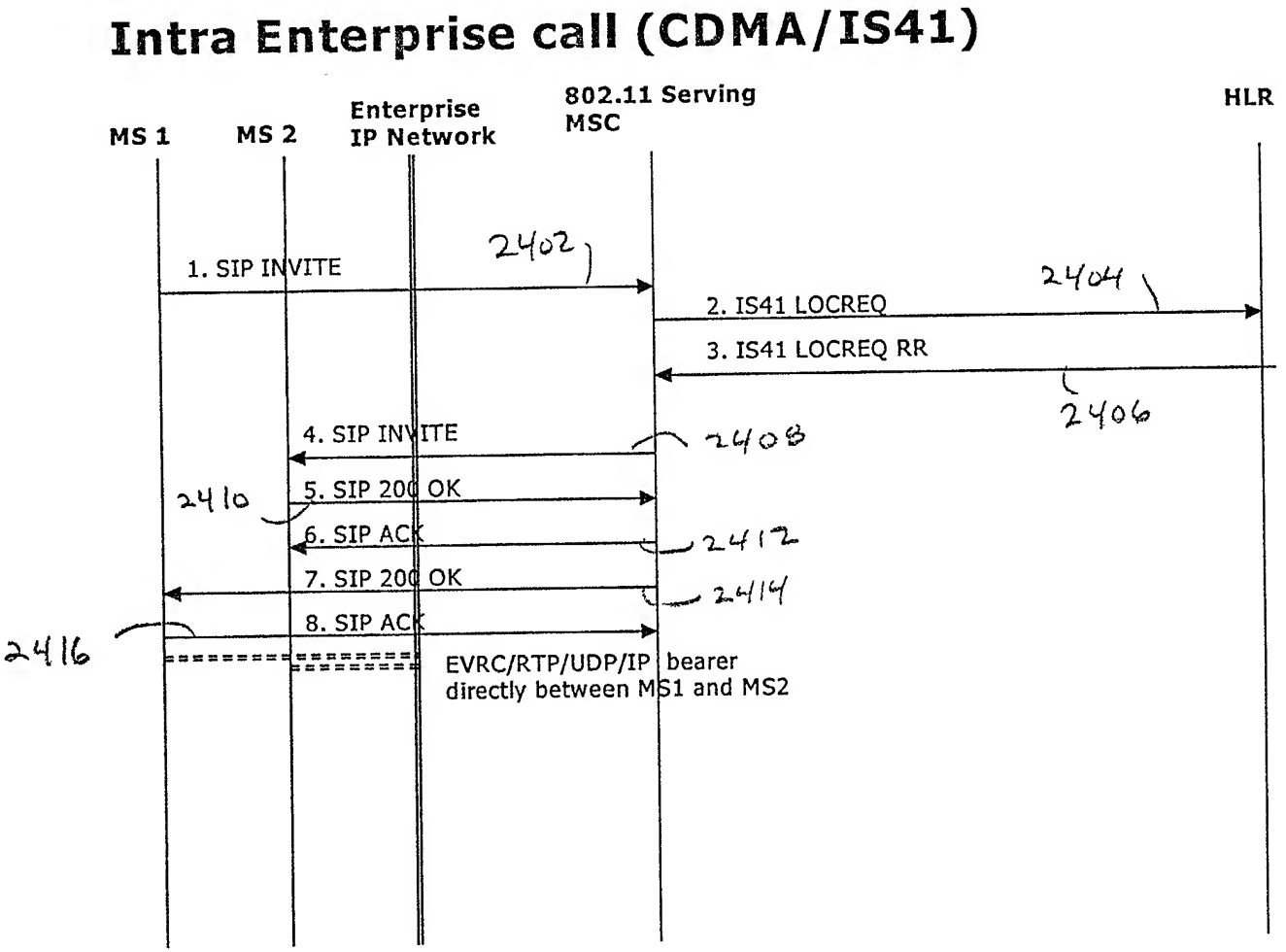

Intra Enterprise call (CDMA/IS41)
MS 1
MS 2
Enterprise IP Network
802.11 Serving MSC
HLR
2402
1. SIP INVITE
2404
2. IS41 LOCREQ
3. IS41 LOCREQ RR
2406
4. SIP INVITE
2408
2410
5. SIP 200 OK
6. SIP ACK
2412
7. SIP 200 OK
2414
2416
8. SIP ACK
EVRC/RTP/UDP/IP bearer directly between MS1 and MS2

Figure 25

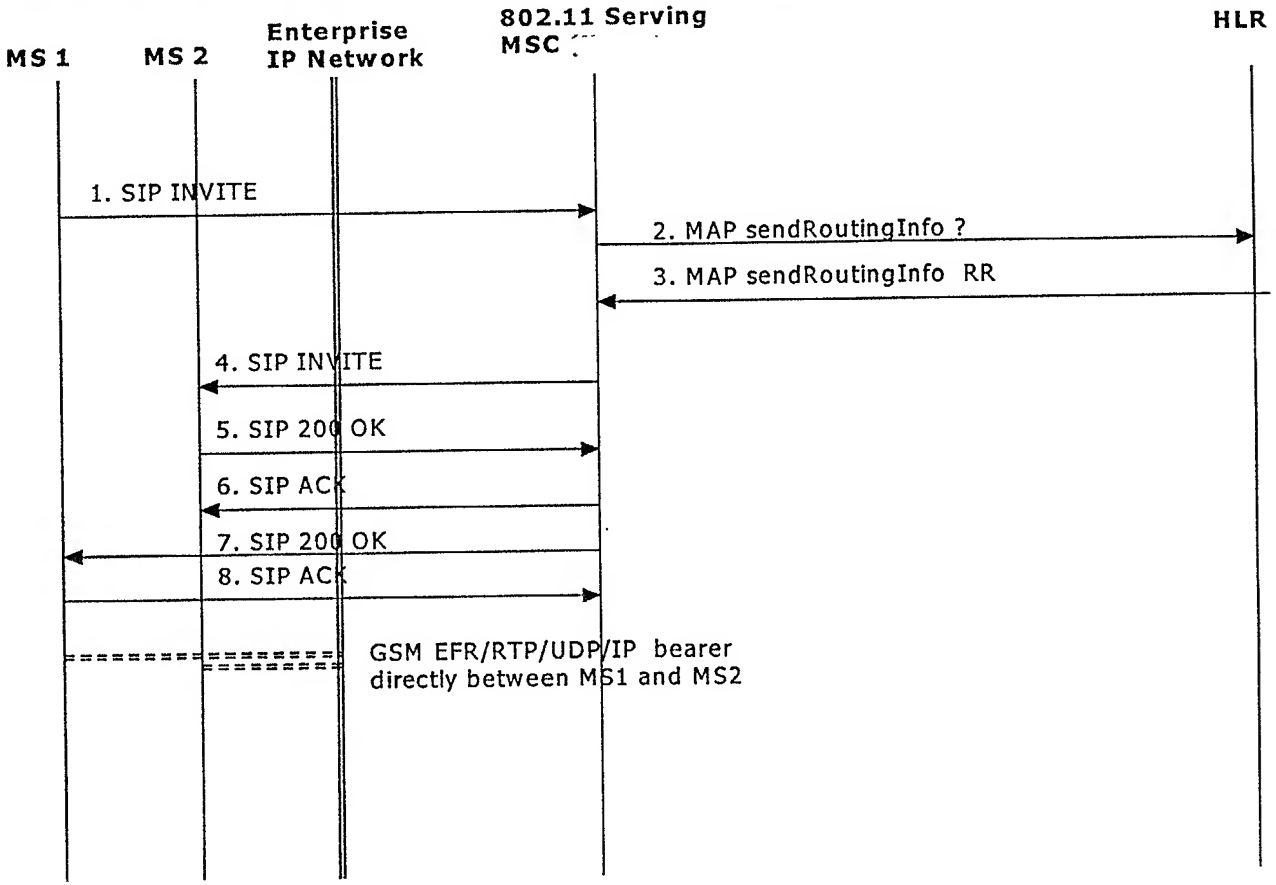

Intra Enterprise call (GSM/MAP)
MS 1
MS 2
Enterprise IP Network
802.11 Serving MSC
HLR
1. SIP INVITE
2. MAP sendRoutingInfo ?
3. MAP sendRoutingInfo RR
4. SIP INVITE
5. SIP 200 OK
6. SIP ACK
7. SIP 200 OK
8. SIP ACK
GSM EFR/RTP/UDP/IP bearer directly between MS1 and MS2

Figure 26

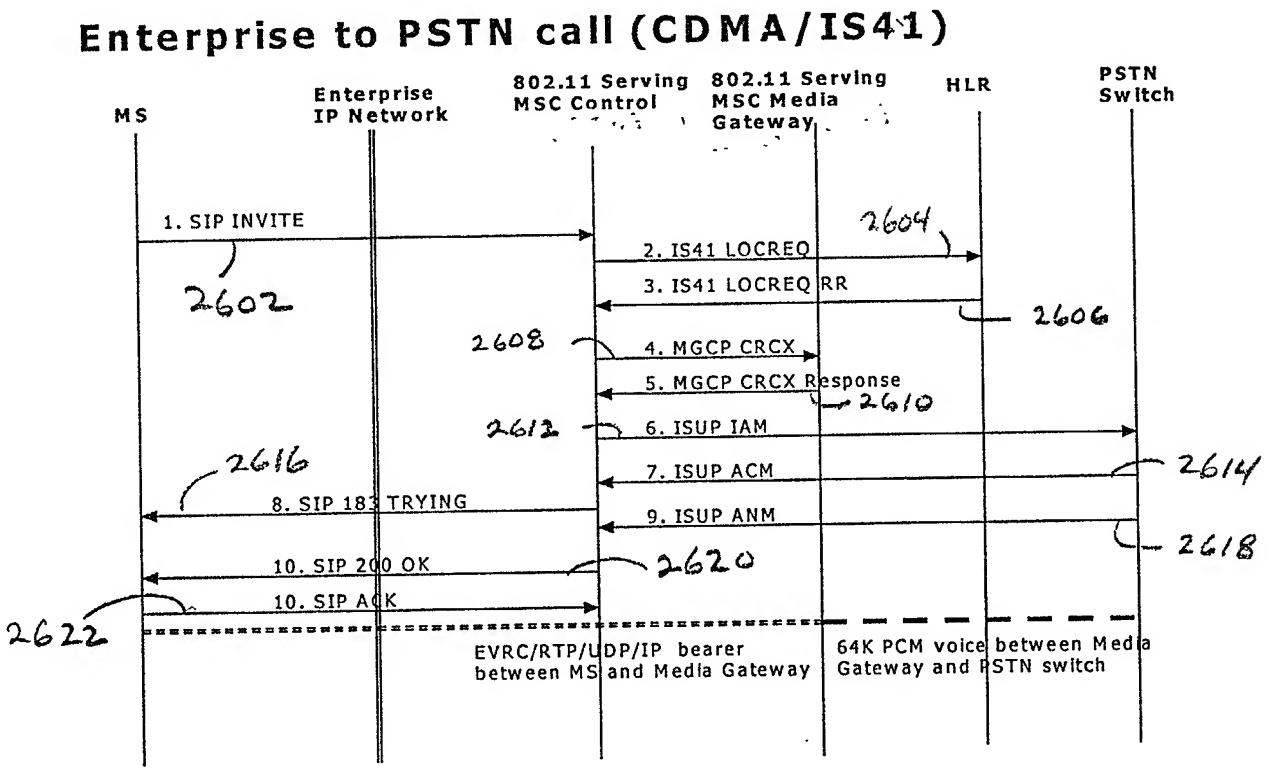

Enterprise to PSTN call (CDMA/IS41)
MS
Enterprise IP Network
802.11 Serving MSC Control
802.11 Serving MSC Media Gateway
HLR
PSTN Switch
1. SIP INVITE
2602
2604
2. IS41 LOCREQ
3. IS41 LOCREQ RR
2606
2608
4. MGCP CRCX
5. MGCP CRCX Response
2610
2612
6. ISUP IAM
2616
7. ISUP ACM
2614
8. SIP 183 TRYING
9. ISUP ANM
2618
10. SIP 200 OK
2620
10. SIP ACK
2622
EVRC/RTP/UDP/IP bearer between MS and Media Gateway
64K PCM voice between Media Gateway and PSTN switch

Figure 27

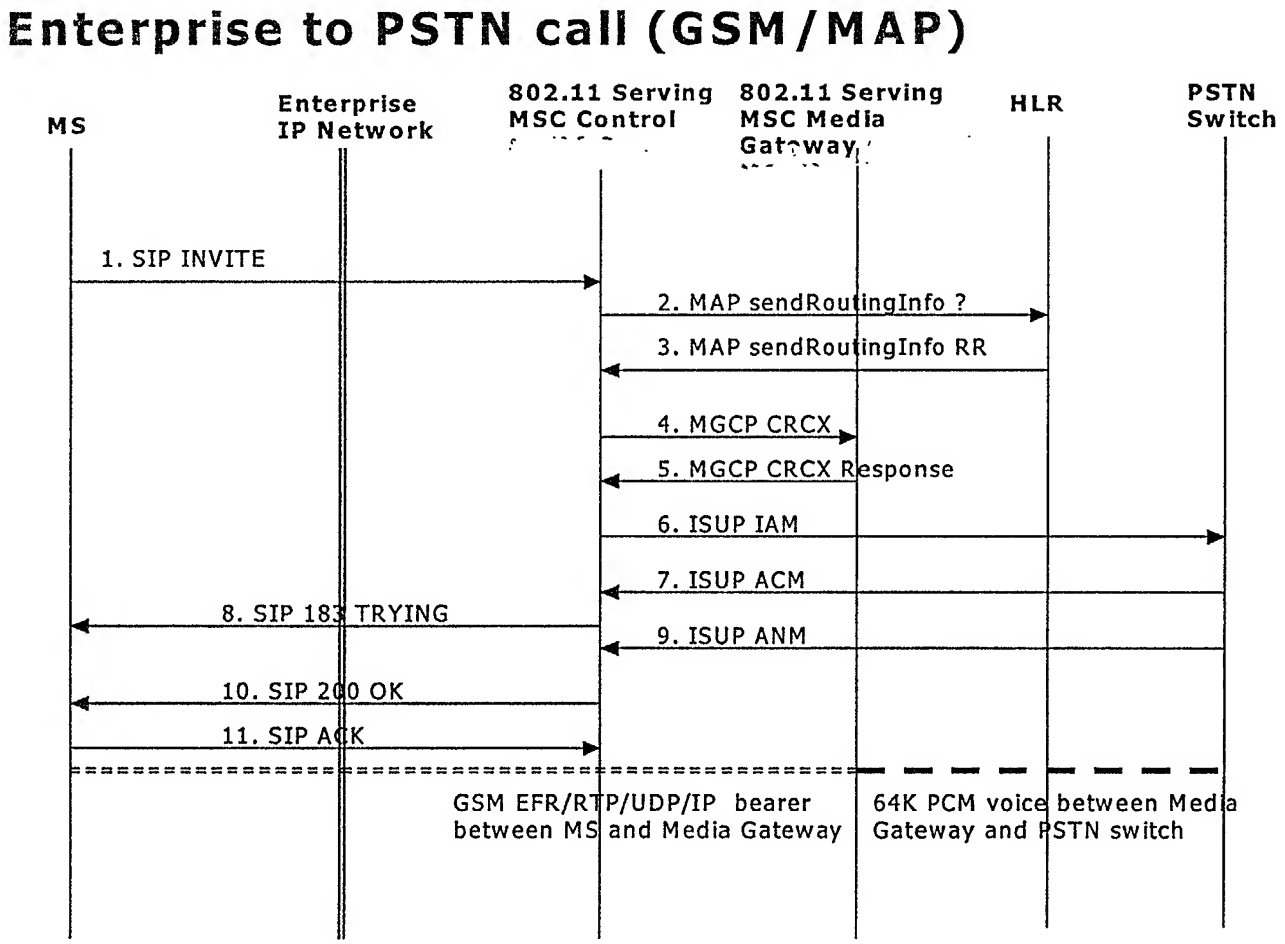

Enterprise to PSTN call (GSM/MAP)
MS
Enterprise IP Network
802.11 Serving MSC Control
802.11 Serving MSC Media Gateway
HLR
PSTN Switch
1. SIP INVITE
2. MAP sendRoutingInfo ?
3. MAP sendRoutingInfo RR
4. MGCP CRCX
5. MGCP CRCX Response
6. ISUP IAM
7. ISUP ACM
8. SIP 183 TRYING
9. ISUP ANM
10. SIP 200 OK
11. SIP ACK
GSM EFR/RTP/UDP/IP bearer between MS and Media Gateway
64K PCM voice between Media Gateway and PSTN switch

Figure 28

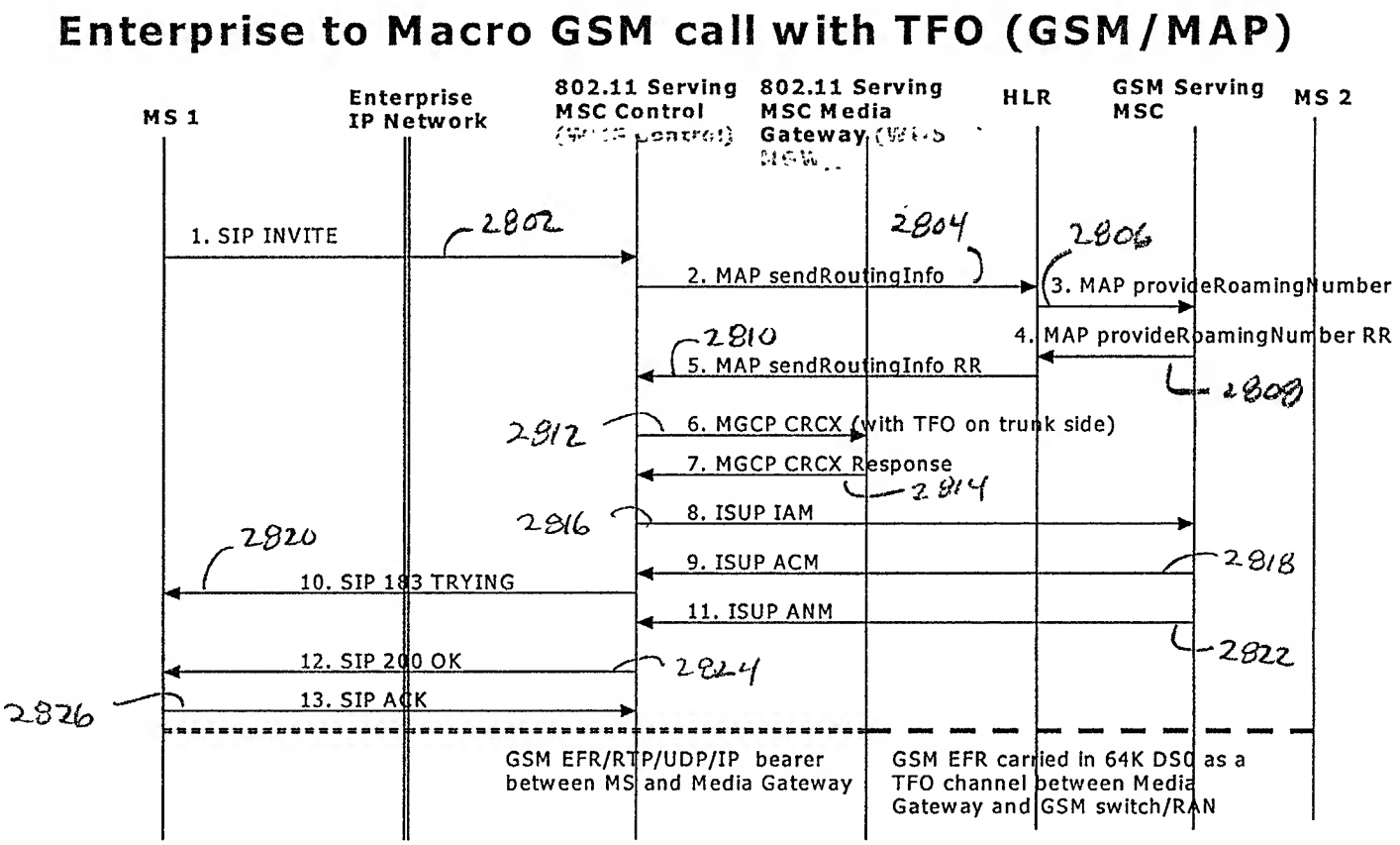
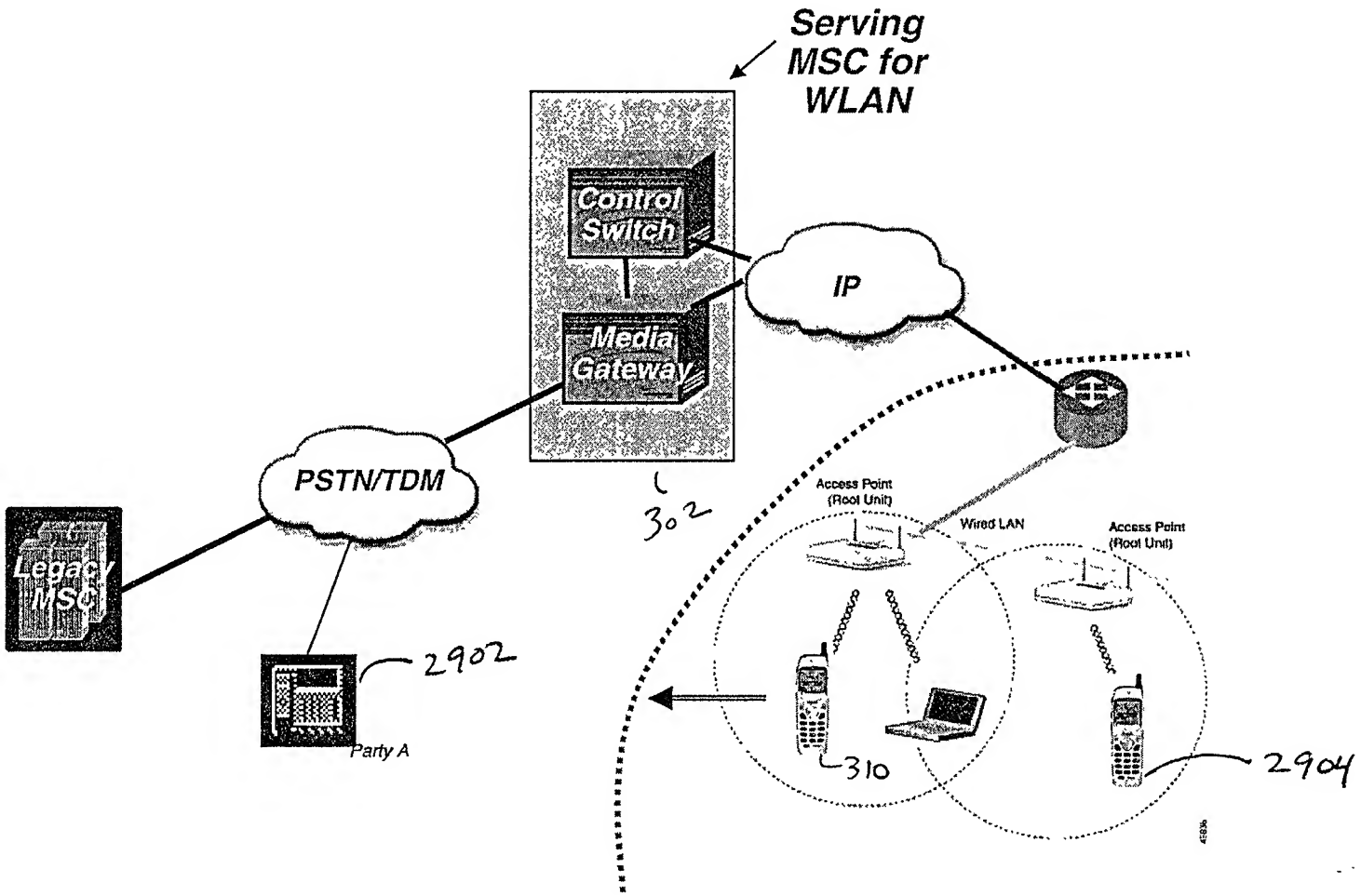

Enterprise to Macro GSM call with TFO (GSM/MAP)
MS 1
Enterprise IP Network
802.11 Serving MSC Control
802.11 Serving MSC Media Gateway
HLR
GSM Serving MSC
MS 2
1. SIP INVITE
2802
2804
2806
2. MAP sendRoutingInfo
3. MAP provideRoamingNumber
4. MAP provideRoamingNumber RR
2810
5. MAP sendRoutingInfo RR
2808
2812
6. MGCP CRCX (with TFO on trunk side)
7. MGCP CRCX Response
2814
2816
8. ISUP IAM
2820
9. ISUP ACM
2818
10. SIP 183 TRYING
11. ISUP ANM
2822
12. SIP 200 OK
2824
2826
13. SIP ACK
GSM EFR/RTP/UDP/IP bearer between MS and Media Gateway
GSM EFR carried in 64K DS0 as a TFO channel between Media Gateway and GSM switch/RAN

Figure 29


Serving MSC for WLAN
Control Switch
Media Gateway
IP
PSTN/TDM
Legacy MSC
302
2902
Party A
Access Point (Root Unit)
Wired LAN
Access Point (Root Unit)
310
2904

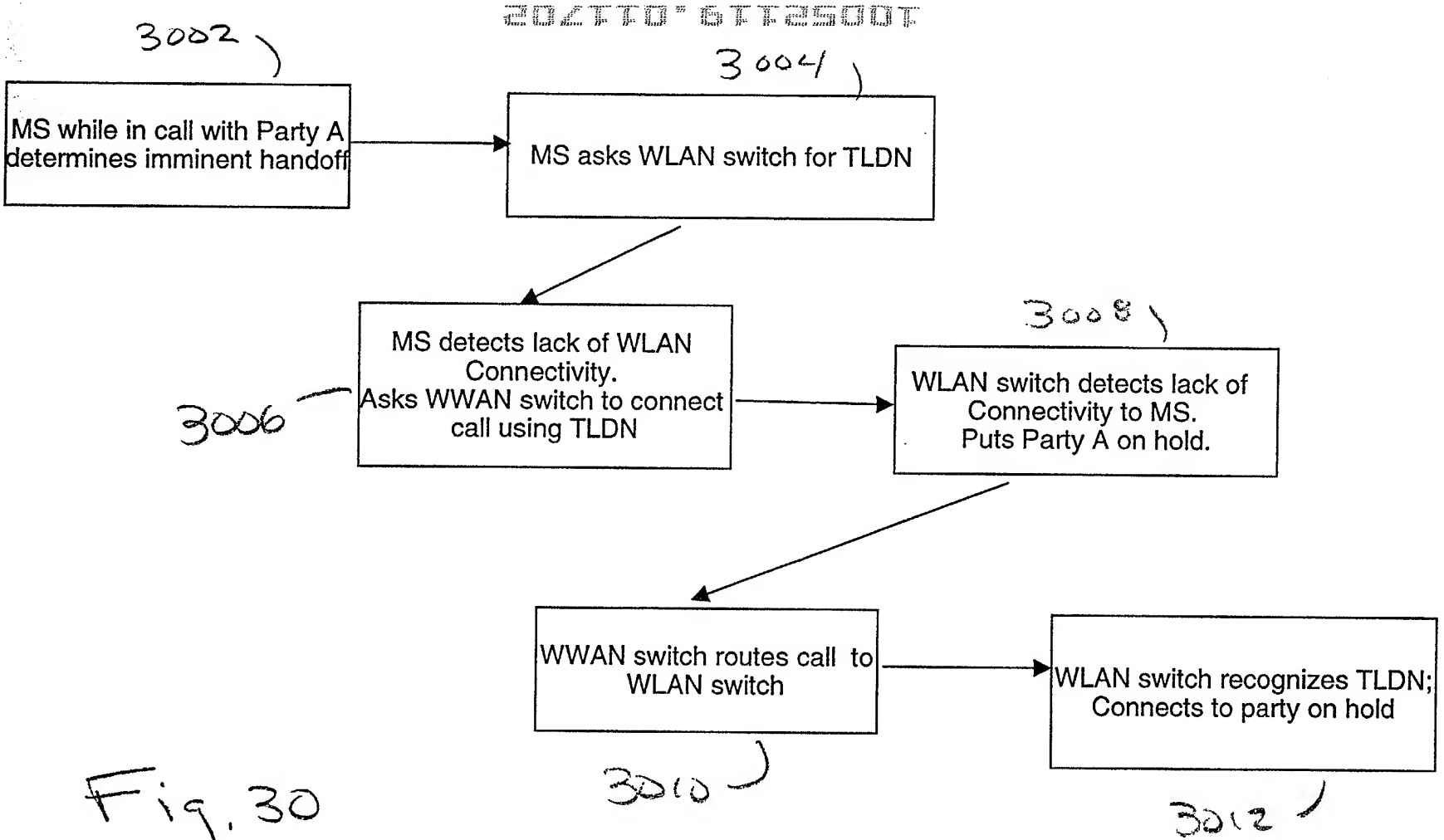
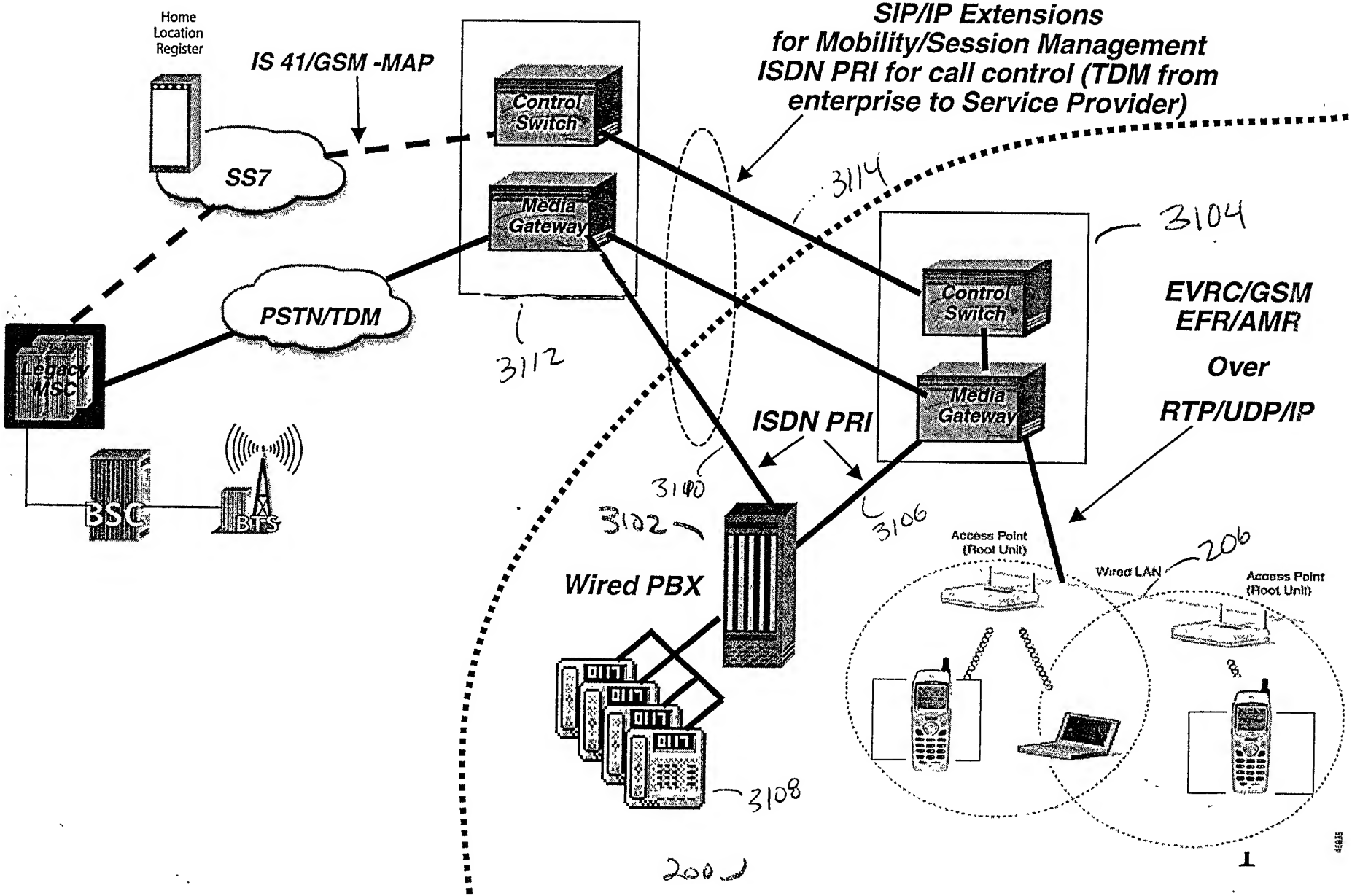

3002
MS while in call with Party A determines imminent handoff
3004
MS asks WLAN switch for TLDN
3006
MS detects lack of WLAN Connectivity.
Asks WWAN switch to connect call using TLDN
3008
WLAN switch detects lack of Connectivity to MS.
Puts Party A on hold.
3010
WWAN switch routes call to WLAN switch
3012
WLAN switch recognizes TLDN;
Connects to party on hold

Fig. 30

Fig. 3


Home Location Register
IS 41/GSM -MAP
SS7
Control Switch
Media Gateway
SIP/IP Extensions for Mobility/Session Management
ISDN PRI for call control (TDM from enterprise to Service Provider)
3114
3104
PSTN/TDM
Legacy MSC
3112
EVRC/GSM EFR/AMR Over RTP/UDP/IP
ISDN PRI
3110
3102
3106
BSC
BTS
Wired PBX
Access Point (Root Unit)
Wired LAN
206
Access Point (Root Unit)
3108
200
1